Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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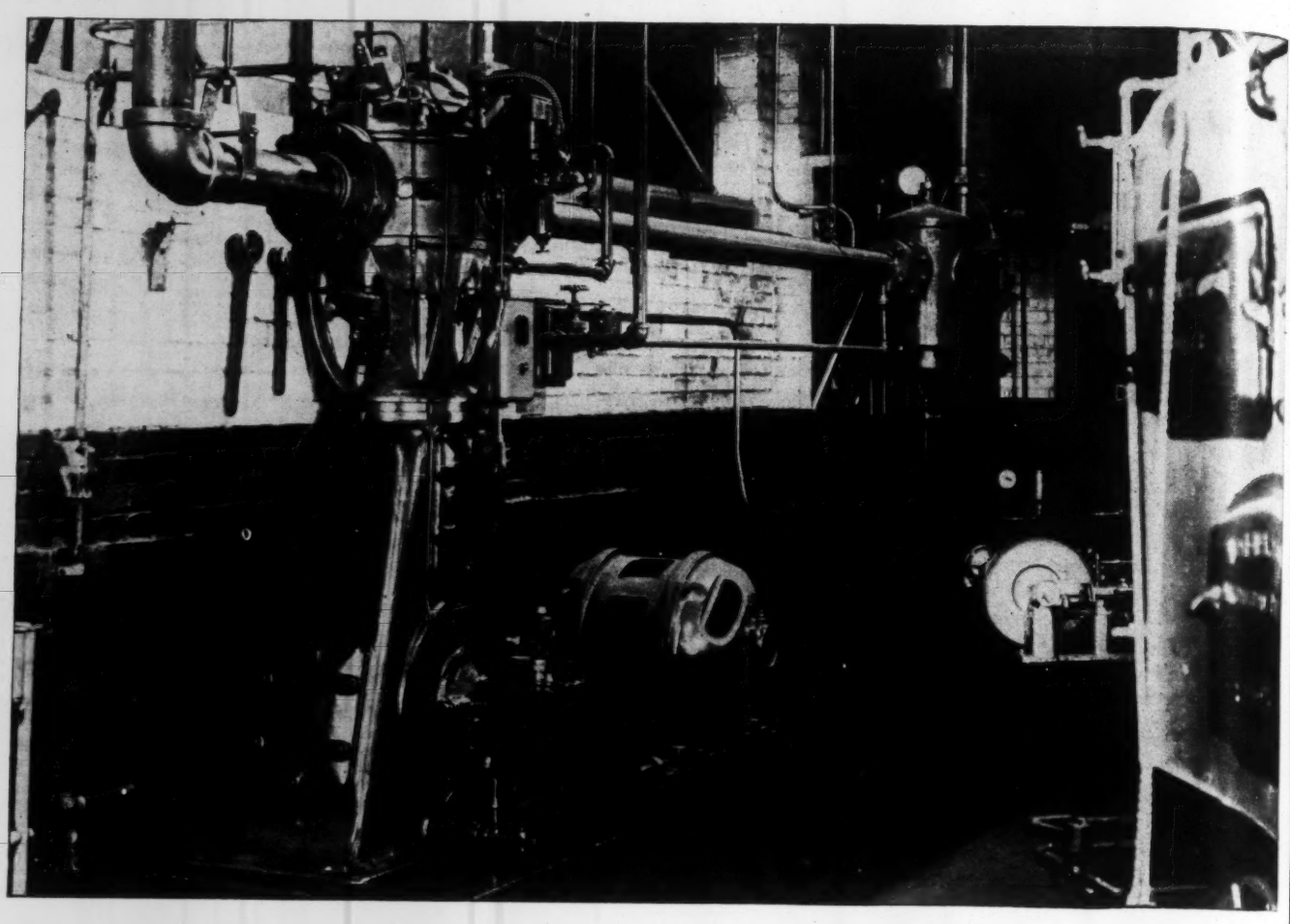

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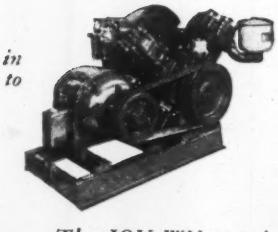

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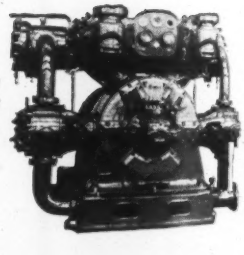

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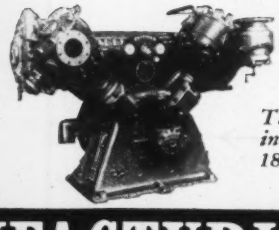

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THE EDITOR'S PAGES

BUILDING CONTRACTS SHOW MIXED TREND

F. W. Dodge Corp. reported last month that contracts awarded for buildings, public works, and public utilities projects in the 37 states east of the Rocky Mountains in April amounted to $842,585,000 to show a 13 percent gain over March and a decline of 4 percent from April of last year.

Increased investment commitments were reported in commercial building, educational and science building, hospital and institutional building, social and recreational building, and single-family houses built to owners' orders for their own occupancy, the April '49 totals in these groups being higher than those for March and for April of last year. Awards for public works were also in the ascendency during the month.

At the month's end, the cumulative record for the year in all building and engineering classifications showed a total of $2,641,656,000 or 8 percent less than the total reported for the corresponding four months of last year.

The deficit for the first four months was brought about by an over-all decline in nonresidential contract commitments of 1 percent to a total of $1,087,589,000, a decline of 17 percent in residential awards to a total of $907,796,000, and a decrease in public works and public utilities awards of 3 percent to a total of $646,271,000.

During the first four months, many classifications were running at a rate higher than a year ago. Those showing gains and the percentage increase over the first four months of last year follow: educational and science, 5; hospital and institutional, 3; public buildings, 96; religious buildings, 19; social and recreational, 13; dormitories, 57; single-family houses built to owners' orders for their own occupancy, 14.

Awards for building and engineering works for public account constituted 38 percent of the total of the April contract volume, and also accounted for 38 percent of the first four months' total.

"QUOTE"

"'Once weatherproofing houses had become general, England had a great advantage in its cheap supply of coal for indoor heating, and it may not be a fortuitous coincidence that the glories of Elizabethan England came soon after the advent of the weatherproofed house.'

"So much for the possible far-reaching effects of indoor heating in winter. This has, so far, been the only type of air conditioning in universal use. Today, however, we can cool in summer as well as we can heat in winter. The powerful and efficient nations of the past century have been those of northwestern Europe and northern North America, where mean monthly summer temperatures of over 75 F are rare and where winter conditions have been controlled by indoor heating. May not vast areas in the sub-tropics become the seat of mighty civilizations, as summer air conditioning meets human physiological needs with similar efficiency?"—*from Temperature and Human Life, by C.-E. A. Winslow and L. P. Herrington, Princeton University Press, 1949.*

WE DON'T NEED BETTER BRAINS: JUST MORE SENSE

Cooperation and understanding in industry, religion, politics, and the home can be secured by the same philosophy that has enabled the engineer to produce his miracles of technology, F. Alexander Magoun, associate professor of human relations at Massachusetts Institute of Technology, declared at the spring meeting of the American Society of Mechanical Engineers. Professor Magoun's address was prepared in collaboration with R. Carter Nyman, personnel director at Yale University.

Professor Magoun characterized the philosophy of the engineer as basically one of truth, reason, and integrity, beginning with an attempt to recognize and define the problem to be solved and continuing with a sincere search for the applicable laws. By applying the philosophy and morality of science to the engineering of human relations we can attain happiness, understanding and cooperation among our fellowmen, said Professor Magoun, who is president of Human Relations Inc., Boston.

"The engineer's philosophy is relatively simple, yet so incredibly effective he has acquired great confidence that any results he predicts will be achieved. The engineer endeavors to apply his principles in the most effective way, and to discover what he has learned in the application thereof. Thus, the engineer has a constructive and self-correcting method because he has a self-correcting philosophy. If we are not to destroy each other, we must apply the philosophy and morality of science to the engineering of human relations," he said.

Professor Magoun said the engineer has replaced our original insecurity and terror of the forces of nature with understanding, respect, and cooperation with the laws of nature, gained only by following a philosophy of truth, reason, and integrity. Since man is as dependent upon his fellowmen as he is upon nature, human problems should be approached with as much professional competence as the engineer employs in pursuing a technical problem, he declared.

"Instead of trying to understand each other, we have endeavored to coerce when we felt strong and to entice when we felt weak," Professor Magoun said. "The result has been a false philosophy of human relations, intolerable relationships of fear, false values, superficial compromises, and dishonesty which have never led to constructive solutions.

"We do not need better brains. We do not need to change human nature any more than the engineers have changed it. For cooperation and happiness, we need only to adopt in industry, in religion, in politics, and in the home the same philosophy which has taken the scientist so far, so fast, in the last 300 years. As before, the first requirement is an honest attempt to find the facts, no matter how disagree-

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THE EDITOR'S PAGES

able. As before, this requires rejecting the old dogmas which led us to reach conclusions before we even knew what questions to ask. As before, we need not only the courage to look, but the capacity to see.

"We must search in our homes, our churches, our factories, and our offices for what will stand up under critical examination, and fearlessly reject all else as false. The engineer's professional philosophy has brought about the development of the physical world. It must now be widened in its application to bring about the development of men."

BIGGER GAS A.C. UNITS NEEDED, SURVEY SHOWS

The possibility of using combinations of gas air conditioning to do a better job with gas should perhaps be explored, according to L. J. Fretwell, chief commercial engineer, Oklahoma Natural Gas Co., Tulsa, at the 1949 American Gas Association sales conference on industrial and commercial gas. He also reported a demand for units bigger than the 3 and 5 ton sizes.

"For example," he said, "suppose we have a commercial application that requires 15 tons of refrigeration which we would like to do with gas air conditioning equipment, and suppose after calculations we found there were 10 tons of sensible load and 5 tons of latent load. If temperature control and humidity control were important on this job, we might find that 10 tons of gas absorption refrigeration and 5 tons for gas humidity control might be a better system than trying to do the entire load with gas absorption equipment. If a humidity control job can be done with gas and the rest of the cooling job can be done more economically with electric compressors, it might pay the gas industry to recommend a combination of gas and 'other' means of air conditioning.

"Installations of gas air conditioning in smaller commercial establishments are proving so satisfactory in operation that demands are being made for gas air conditioning units greater than the 3 and 5 ton units now available," he reported. "To determine the need for gas units of larger capacity, a questionnaire was mailed recently to 35 gas utilities operating in the south and southwest. This questionnaire asked for information on the need for larger gas units of 20, 50, 75, and 100 ton capacity as well as an estimate of the number of each size that could be sold if the equipment were available at reasonably competitive prices. Of the 35 questionnaires mailed, 19 were returned indicating a very great need for larger gas summer air conditioning units and estimating an available market in the territory served by those 19 gas utilities of 1634 twenty ton units, 565 fifty ton units, 338 seventy-five ton units, and 207 hundred ton units, or a total of 2744 units."

OFFERS FELLOWSHIP IN RADIANT HEATING

The engineering experiment station of Montana State College is conducting general research in designing, testing, and analyzing radiant panel heating installations operating under Montana conditions, and a fellowship grant of $1000, payable in 12 monthly installments, has been established to further the study.

Applications should be made as soon as possible for appointment September 15, and should be addressed to Head, Mechanical Engineering Dept., Montana State College, Bozeman.

SEES GENERAL BUSINESS HOLDING AT HIGH LEVEL

In a recent speech at the annual stockholders' meeting—held for the first time in an improvised auditorium in the production aisle in East Pittsburgh—G. A. Price, president of the Westinghouse Electric Corp., stated that in spite of a decline in general business activity this year, there were indications that the total volume of the nation's business for 1949 might not be too far below the peacetime record of 1948.

He further stated that although the demand for capital goods—heavy machinery and equipment—has tapered off, "there are reasons to expect the market for capital goods to hold this year at a physical volume about double the average for the years 1935 through 1939, while production this year should be at least double the 1935-39 average. Even this lower level of operations provides a solid base for continued prosperity—assuming only that it is not destroyed by government policies thwarting private business and private investment."

Despite a period of declining sales and prices, industry will continue to improve its plants and replace its old or obsolete machines in order to cut costs, provided it can find the money to invest in these improvements, he declared.

20 Years Ago

Knowing where, when, and how the steam, water, compressed air, refrigeration, and the other services that are conveyed through piping are used in an industrial plant, an overall standard of operating requirements can be established against it, the daily plant operation can be checked for wasteful distribution and utilization. The result will be economy in fuel and economy in capital investment for equipment, said George B. Mulloy in his article in the June 1929 HPAC.

* * * * *

The first of many valuable articles on piping—and particularly codes and standards for piping—which Sabin Crocker, outstanding authority on this subject, and member of HPAC's board of consulting and contributing editors has written for publication in these pages, appeared in our June 1929 number. He reviewed pipe thread standardization, flange drilling templates, the American Standards Association's piping standards, ASTM materials specifications, and the piping standards of particular user groups.

* * * * *

"The year 1929 may be set down as the year in which air conditioning for human comfort was inaugurated upon a major scale," said the author of an article in our June issue that year in which was described the new air conditioning installation for the Chicago Title and Trust Co.

"OPEN for DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address them to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2

SANITARY VENTILATION BY AIR DISINFECTION

THANK YOU FOR the invitation to comment on Cyril Tasker's fine review of the British paper on methods for sterilizing air, published in the May HPAC. I have not yet seen the original publication but am of course familiar with the excellent work on which it is based.

Shortly after our laboratories for the study of airborne infection had been organized at the University of Pennsylvania 12 years ago to develop the researches on airborne infection commenced at Harvard, I was asked by Sir Patrick Laidlaw for the basic information upon which to found a project of the Medical Research Council of Great Britain. Unfortunately, the untimely death of Dr. Laidlaw before receipt of this material deprived us of his mature experience in the field of influenza and airborne infection. However the work was carried on by a competent group in the council and we have recently received special report series No. 262 on studies in air hygiene (some 356 pages). Undoubtedly the paper reviewed by Mr. Tasker is the culmination of this excellent work; the medical profession—having found the subject of airborne infection sound—is presenting the problem of sanitary ventilation as a task of the heating and ventilating engineers of Great Britain.

The task force of the American Society of Heating and Ventilating Engineers has already completed the first stage of its mission; a report of the technical advisory committee on air sterilization has presented to the ASHVE definitions, formulations, and factors governing sanitary ventilation by air disinfection. The ASHVE has submitted this report to the American Public Health Association who, through its committee on research and standards, is referring it to the subcommittee on air sanitation for coordination. Thus we have already advanced to the stage of preparing specifications and standards of practice of sanitary ventilation and the ASHVE has assumed its responsibility of leadership. I hope this inaugurates the practical field of sanitary ventilation as an important factor in public health.

In this connection, I might also mention the excellent work reported by Hans E. Ronge from the University of Uppsala in Sweden, on ultraviolet irradiation with artificial illumination. The particular value to engineers of this report is the elegant mathematical analysis of the basic problems of sanitary ventilation by air disinfection.

I have been working during the last two years upon a comprehensive integration of all the work both in this country and abroad which I hope will soon be ready for practicing engineers and public health authorities.

Naturally, I think some recognition should be made of the fact that this work on sanitary ventilation originated in this country in our laboratories, but we are more impressed with the fact that the British are following than that we are leading.—WILIAM F. WELLS, associate professor of research in airborne infections, school of medicine, University of Pennsylvania.

HEAT RELEASE RATES WITH FLOOR HEATING

WITH REFERENCE to the article by Paul S. Park in the March HPAC on the subject of floor surface temperatures, and the comments by D. L. Mills in April may we go on record as being in complete agreement with Mr. Park? His article clearly outlined two conflicting points of view on the subject of radiant heating, which have not been properly considered as yet in the literature.

The root of the misunderstanding seems to lie in the fact that too much of the writing on this theme has been done by individuals who, in our estimation, are very long on theory but somewhat short on the practical aspect of the matter. There is no doubt that there is a limit on heat output of floor panels, because of restricted surface temperature—but the limits already suggested, viewed in the light of actual experience with installations, are definitely too conservative.

As Mr. Park pointed out in his article, the faults appear to lie between floor panel heat output ratings which are too conservative, and present methods of estimating heat losses which are definitely on the generous side.

It is fortunate for us that, when radiant heating was first introduced to Canada, we followed Mr. Park's line of reasoning, even though it conflicted with statements which had even then been made by certain authorities. Because of the rigorous conditions encountered here in the winter months, usual conservative floor panel heat output ratings make ceiling panels mandatory in about 75 percent of cases. In this country, the adoption of ceiling panels means considerably higher cost, assuming that concrete is available for a floor panel; therefore, if we had followed floor panel ratings most often advocated in the literature, we would have penalized the use of this method of heating.

At the time of writing, there are over 2000 installations of radiant heating in Canada, and probably 60 percent of them are of the floor panel type. Of this 1200, at least 80 percent operate at heat release rates substantially above those usually suggested in the literature, and probably 200 of this category supply heat, during severe weather, at rates exceeding 70 Btu per sq ft of panel per hr.

Mr. Mills suggests that proper instrumentation would verify such cases, which is quite true if a laboratory setup could be obtained on the site. We question the value of this, however, since the design of future installations must be reconciled with existing heat transfer factors of materials, unless such factors are revised as the result of many tests.

It does not seem unreasonable, therefore, to revise our thinking as

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"OPEN for DISCUSSION"

regards the maximum permissible heat release rate for floor panels as determined by laboratory experiments and the observed rate, based on present accepted methods of calculating heat losses. There is no question that both are in error, as Mr. Park pointed out, but since most of us must fall back on the ASHVE's Heating, Ventilating, Air Conditioning Guide for coefficients of heat transmission, we think that progress will be best served by rating floor panel heat output on that basis.

Robert W. Roose, in his article, Call It Radiant or Panel Heating? in the April issue, brings up a point which may interest many. In our humble opinion, the name "panel heating" stems from Europe and connotes, to our way of thinking, a practice which is at variance with that generally followed on this continent. It infers local, relatively high temperature, ceiling zones and no floor panels whatever. It means also, to us, that the entire area available as a panel is not actually used; for instance, only part of a ceiling is heated.

We do not think that this is the case in America, as accepted practice seems to utilize entire floor or ceiling areas for the panels. The result is lower average temperatures and probably more comfortable installations. There should, we think, be a differentiation between the two methods—a differentiation as pronounced as the difference between the names "radiant" and "panel." We will vote for "radiant heating," for that name suggests something new and comfortable, which, in essence, states the case exactly.—W. A. CONNOR, service engineer, radiant heating div., Page-Hersey Tubes, Ltd., Toronto.

DESUPERHEATING COILS ON EVAPORATIVE CONDENSERS

CONCERNING THE subject of scale formation in evaporative condensers and D. D. Wile's comments thereon in recent issues of HPAC, it seems Mr. Wile and I differ considerably on the importance of desuperheating coils.

I am impressed with desuperheating coils for two reasons; first, because I believe that a desuperheating coil will increase the condenser thermal efficiency and second, that it will prevent considerable scale formation under certain conditions.

It seems to me for a certain size condenser, if part of its capacity is placed in the desuperheat coil, more complete heat transfer will occur per unit weight of air and water moved because during water evaporation heat is taken from the air as well as water and the heat transfer from tube to water is greater than from tube to air. Where no desuperheat coil is used, the cooling capacity of the exhaust air is lost. It would thus appear that a condenser using a desuperheat coil would cool more efficiently and not be any larger or more expensive than one of the same capacity without a desuperheating coil. Furthermore, the more heat removed by the desuperheating coil the better the heat transfer conditions in the wet tube bundles will be.

From my point of view, there are two reasons desuperheating coils help prevent and in many cases eliminate scale formation on wet coils. The first is that by proportioning the condenser load between the desuperheating coils and the wet tubes, the load on the wet tubes for the same amount of water moved (as in a condenser of like capacity with no desuperheating coil) will be less with consequently less scaling or no scaling depending upon operating conditions. In other words, the use of a desuperheating coil has the same effect as an increase in water supply.

Scaling is a function of the weight of water evaporated per unit of spray water moved per unit of wet tube load, a factor I will refer to as E. The greater the loading of the wet tube bundle, the greater will be the evaporation rate, other factors remaining constant. Therefore, the more condenser capacity located in the wet tubes, the greater will be the rate of evaporation for a condenser of fixed size resulting in increased mineral concentration of the water near the lower coils with a corresponding increase in the probability of scaling.

As I have pointed out previously additional water spray directed at the lower coils will help hold the mineral concentration below the precipitation point. Critical mineral concentration, in my opinion, may also be prevented at the lower coils by decreasing the load on the wet chamber with desuperheating coils so that variation in mineral concentration from top to bottom will vary only between narrow limits.

In a general way, for a condenser of fixed size and water supply equipped with a desuperheating coil, it might be concluded that:

1) Scaling varies directly with E.

2) Condenser capacity in desuperheating coils is some inverse function of E.

3) Condenser capacity in the wet coils varies directly with E.

The narrower the limits of variation of mineral concentration in the spray water, the less will be the value of E and therefore, the possibility of scaling. However, too narrow a variation in mineral concentration means less evaporation and results in decreased condenser capacity. The mineral concentration of the water in the condenser reservoir will determine how near the critical concentration the mineral will be forced by the factor E. It might also be mentioned at this point that evaporative condenser capacity must be based on mineral content of water as well as thermal load and wet bulb temperature.

The second reason for scale prevention applies when desuperheating coils are placed in the inlet air to the condenser. This will raise the water temperature at the lower coils and hold the mineral in solution where precipitation would otherwise take place at a lower temperature.

It might be finally concluded that desuperheating coils not only increase the thermal efficiency of a condenser but also prevent scaling to the degree indicated above.

It would please me no end if Mr. Wile, or anyone else, would undertake to obtain and publish some quantitative data on aspects of the above.—O. GERMANY, Airtemp engineer, export div., Chrysler Corp., Detroit.

Air view of the Fresh Meadows project as it will appear when complete, with the store area in the foreground. Note the large open spaces, play areas, and parking facilities

Central Heating and Cooling at Big New York Life Project

BOLDLY CONCEIVED and daringly executed, the New York Life Insurance Co.'s Fresh Meadows project, on Long Island, is now coming to life as the home of some 10,000 persons and the shopping center for perhaps 40,000 more.

The name itself—Fresh Meadows—was already well-known as a delightful country club. It creates in the mind the thought of a pleasant place to live. The architects have translated that thought into actuality. The development has a homelike, pleasant, and attractive appearance.

This is one of the largest projects of its kind in the United States. Hence, it is of more than usual interest to give a picture of what the owners had in mind and then to examine the reasons why various things were done.

The whole project—including commercial areas—occupies 170 acres of what was formerly the golf links of the Fresh Meadows country club along Horace Harding Blvd. between Flushing and Jamaica on Long Island. The residential part comprises 158 acres and on this there are two 13 story buildings for 624 families and 136 two and three story buildings averaging about 18 families each. All together, over 3000 families will enjoy life at Fresh Meadows.

LEWIS SMITH, of the C. A. Dunham Co., New York City, describes the heating and air conditioning installations at the Fresh Meadows project of the New York Life Insurance Co. on Long Island. Built for a community of 10,000 persons, with a shopping center for perhaps 40,000 more, the 13 story, three story, and two story buildings are heated by subatmospheric steam generated at a central plant. A unique feature is the central refrigeration plant that furnishes chilled water for air conditioning the stores and the theater; Btu totalizing and recording meters enable charging for the cooling at a rate per Btu actually used

Commercial Center Carefully Planned

Since there were inadequate commercial facilities in the neighborhood to take care of 10,000 people, studies were made of the various types of stores required. The commercial center was then designed and tenants were selected according to this definite allocation of space. This study even went so far as to determine how many doctors and dentists were required and the owners are putting up a professional building with proper division among the various fields of medicine.

The largest buildings are a department store and a 2100 seat theater. Six other buildings will have a total street frontage of 1120 ft, and will be divided into 35 units. Even a post office is included which will maintain a carrier station and will bear the Fresh Meadows postmark. Parking space will be pro-

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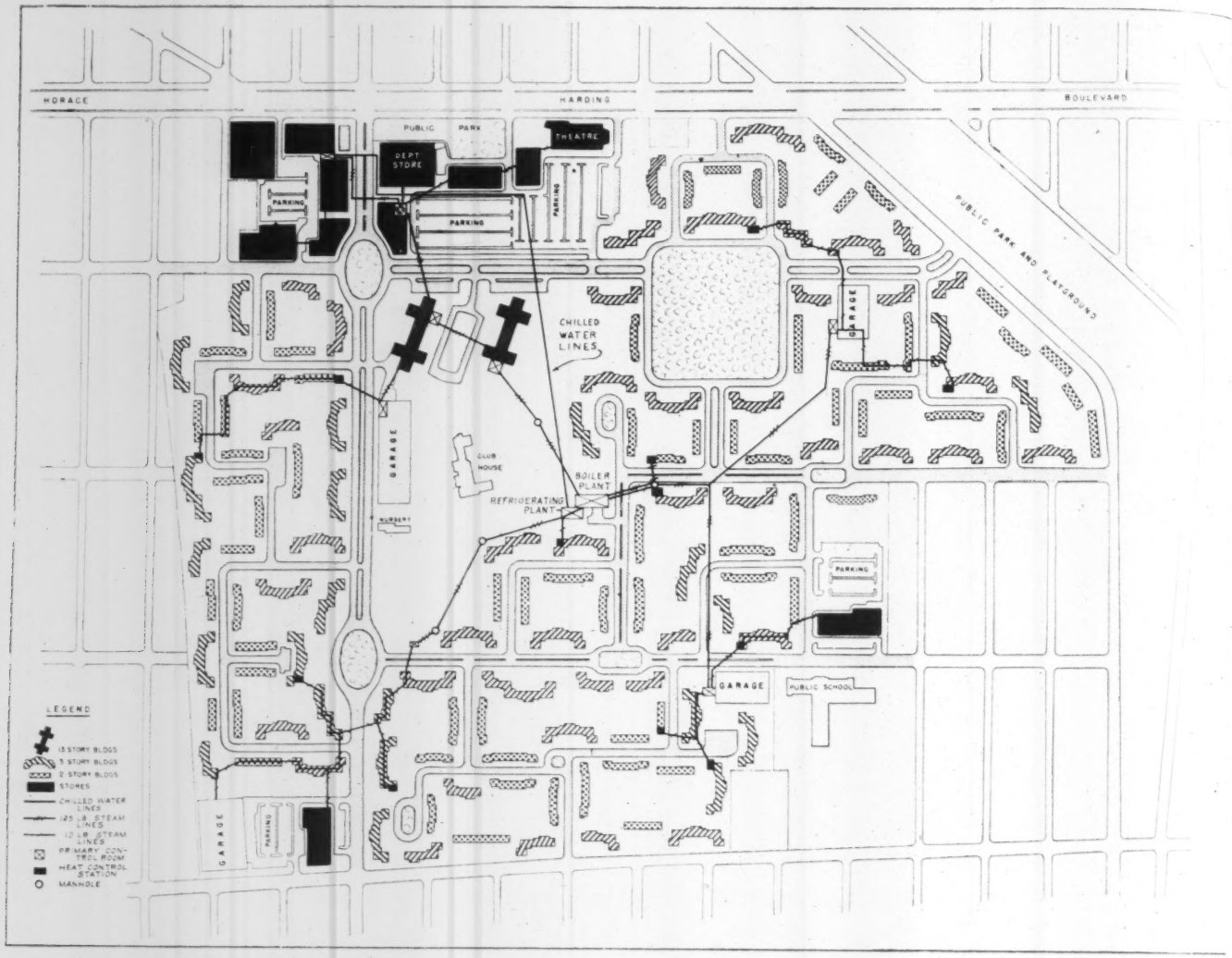


This site plan of the Fresh Meadows project shows the 125 lb steam lines from the boiler plant to the control rooms, the 10 lb steam lines to the heat control stations, and the chilled water lines for furnishing refrigeration effect for air conditioning

vided for more than 1000 cars, and throughout the property there are four fireproof garages to accommodate approximately 1400 cars.

The needs of the children have been taken care of not only with play areas but with a complete nursery school to be erected on the property. In addition the city has completed a new public school on a site deeded by New York Life.

Full advantage has been taken of the rolling countryside to give attractive arrangement of buildings and privacy for the tenants as well as safety for the children.

Except in the two 13 story buildings, there is a considerable variation in the arrangement of the apartments. Some are on two floors and all are arranged with cross ventilation.

Considerations of climate and cost made it plain that some form of radiator or convector heating would be necessary. The decision then had to be made between steam and hot water for the heating medium. This decision was tied into the question of central versus group boiler plants, or even a boiler for each building.

For a project with such attractive landscaping as this one, the mere requirement of finding 138 fueling points and building 138 stacks alone would have ruled out individual building plants. The cost of providing boiler rooms in buildings which have either no basement or only partial basements would have been prohibitive. Finally, the operating and maintenance costs of 138 boiler plants added to the previous considerations made this idea unworthy of further study.

Group plants are a logical next step and serious consideration was given to this idea. It would have been possible to use perhaps 10 or 12 such plants, but carrying through the same line of reasoning which was applied to the individual plants lead to the inevitable conclusion to use a central plant. In such a plant it would also be possible to provide for using either coal or oil—which is an important factor in these days of shortages and surpluses of fuels.

Having arrived at this decision, a study of pipe sizes and load distribution showed that 125 lb pressure steam should be used for generation and distribution. There would then seem to be no logic in using converters for hot water heating; hence, the final decision was to use steam for heating.

"Heating Without Control Is Absurd Waste"

Heating without adequate control is an absurd economic waste. Manual control spread over 170 acres would have meant a small army of operators on duty. Hence,

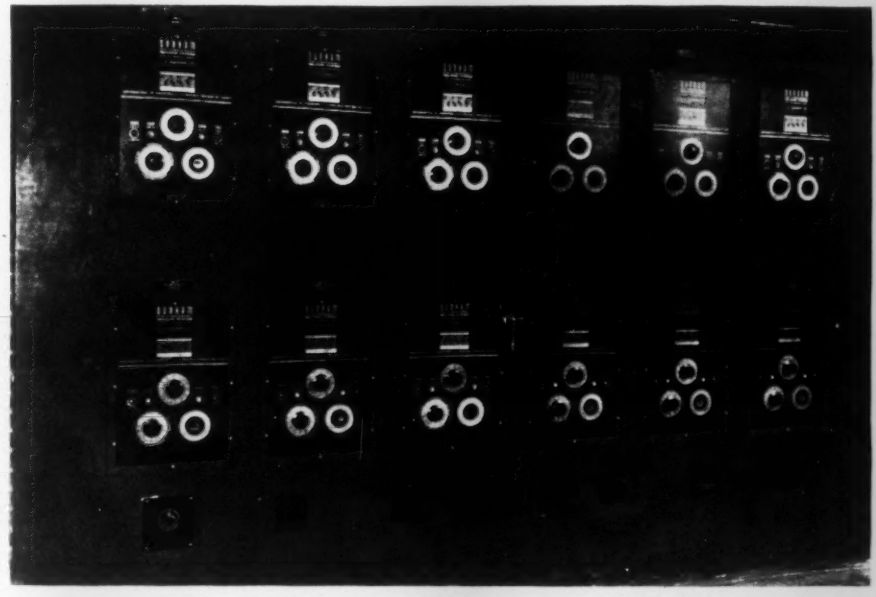
some form of automatic control was essential. To keep maintenance and operating labor costs at a minimum there should be as few controls as possible and these should be concentrated in the central plant.

Designing the Distribution System

The next step was to design the underground distribution system. After study of the topography and the arrangement of the buildings, nine control points were selected where the 115 lb header pressure is reduced to 10 lb. Three of these are in the basements of buildings, three are in underground rooms attached to stores or garages, one is in a garage, one is in a small building erected for this purpose, and one is in the central plant.

Since two of these control rooms each serve one building only, and two are for stores, the other five would serve 134 buildings, an average of almost 27 buildings each. Pipe sizes for low pressure heating for such long runs, regardless of topography, would have been uneconomical and after juggling the layout around, it was finally found that by using 21 heating zones, no pipe in any zone would exceed 8 in., no pressure drop in the steam heating mains would exceed 1 lb, and return mains would flow by gravity to all the pumps without lifts and without deep trenches. This placed an average of six to seven buildings on one heating zone.

Taking advantage of topography and the elevation of buildings, it was found that whereas 21 heating zones were needed only 14 heat control stations were required and three of these are in the high pressure control rooms. The domestic water heaters are also in these heat control rooms, two heaters in each regardless of the number of heating zones. The domestic hot water lines follow the steam main trenches in general and the returns come back to a header in the control room, each return being fitted with a balancing valve. There is one circulating pump between this header and the tanks.



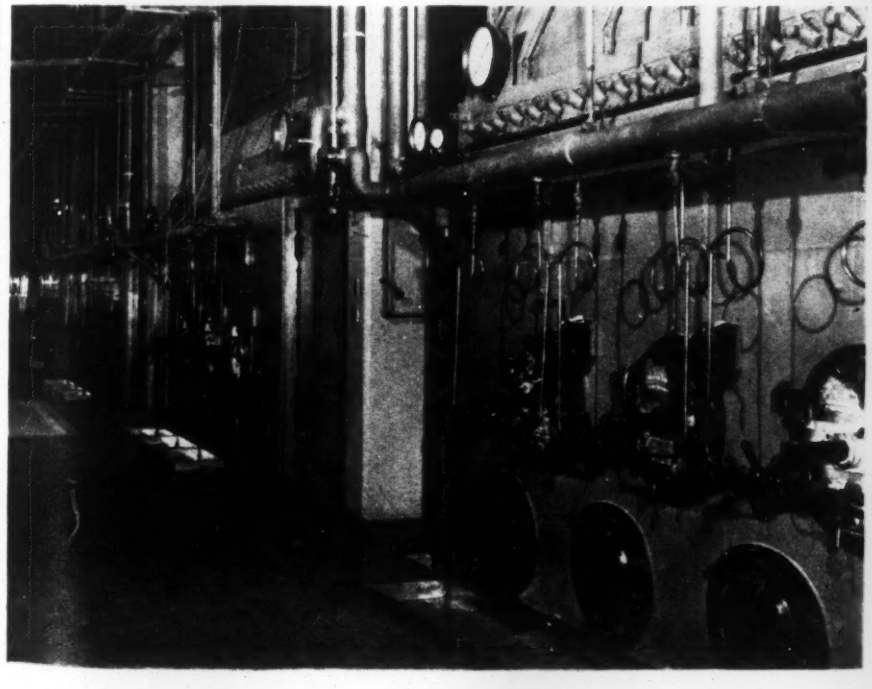
The heating system control panels are in the central plant to simplify operation. This is one of two panelboards; it controls 12 zones automatically, has seven additional remote manual controls

Heating Control Panels in Central Plant

In order to simplify operation and to reduce the number of field men, all the heating system control panels are in the central plant. From those panels the operator can open the control valves manually in the morning, enabling him to take advantage of weather conditions and to control the loading of his boilers so that short peak loads often requiring the starting of an extra boiler are eliminated. The operator is also able to read the percentage of opening of each zone valve, the percentage of heat in each zone, to make corrections for unusual operating conditions; and, in fact, to operate each zone manually if necessary. He can of course shut down at night according to the weather rather than at a fixed time.

In addition to the panels for control of the residential zones, there are two panels for store heating and four small panels for opening and closing the valves at the four garages.

Three mechanical atomizing wide range oil burners are installed in each of the four boilers. The center burner may be quickly removed and a steam atomizing burner substituted for light loads in summer. The furnaces are arranged so that stokers can be installed in place of the oil burners should this become economical



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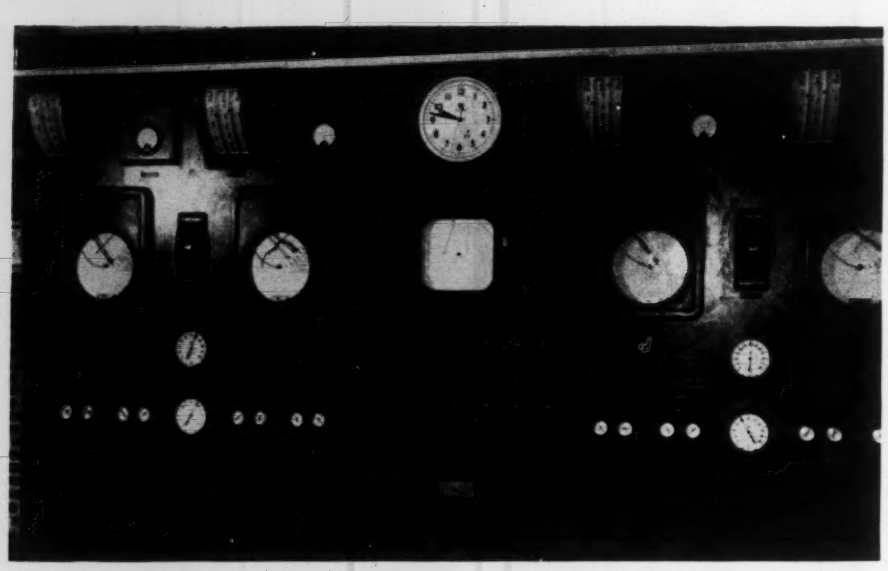


The draft and combustion control board for the four boilers, which includes haze indicators to check on smoke

The central boiler plant is in a main building 128 ft x 51 ft and 32 ft high above grade with a low extension on one end to house the refrigeration equipment. The stack is brick, 185 ft high, 12 ft inside diameter at the base tapering to 9 ft 6 in. at the top.

Can Change From Oil to Coal

The four boilers are of the integral furnace type with two drums, designed for 200 lb pressure, operating at 125 lb per sq in. Each is capable of operating continuously at a rate of 44,000 lb per hr of steam at an efficiency of 82.6 percent, and a maximum rate for emergencies of 55,000 lb per hr.

Three mechanical atomizing wide range oil burners are installed for each boiler but the center burner may be quickly removed and a steam atomizing burner substituted for light loads during the summer. The furnaces are arranged so that in a reasonable time stokers can be installed in place of the oil burners in the event it becomes economical to change to coal firing.

The forced draft fans are installed in the rear aisle of the boiler room and blow the air for combustion into and through a chamber under the floor of the furnaces to preheat the air. The usual surge tank, feedwater heater, chemical treatment plant, boiler feed pumps, and water level controls are embodied in the design, together with a pneumatic combustion control system.

Upon reviewing the plans for the arrangement of equipment in the boiler house, as well as in the field, the owner's operating staff gave serious thought to convenience and ease of control insofar as these factors affect labor costs. It was found that by rearrangement of parts and concentration as far as possible within easy reach of one man, the number of men required could be substantially reduced.

Ease of Operation Provided for

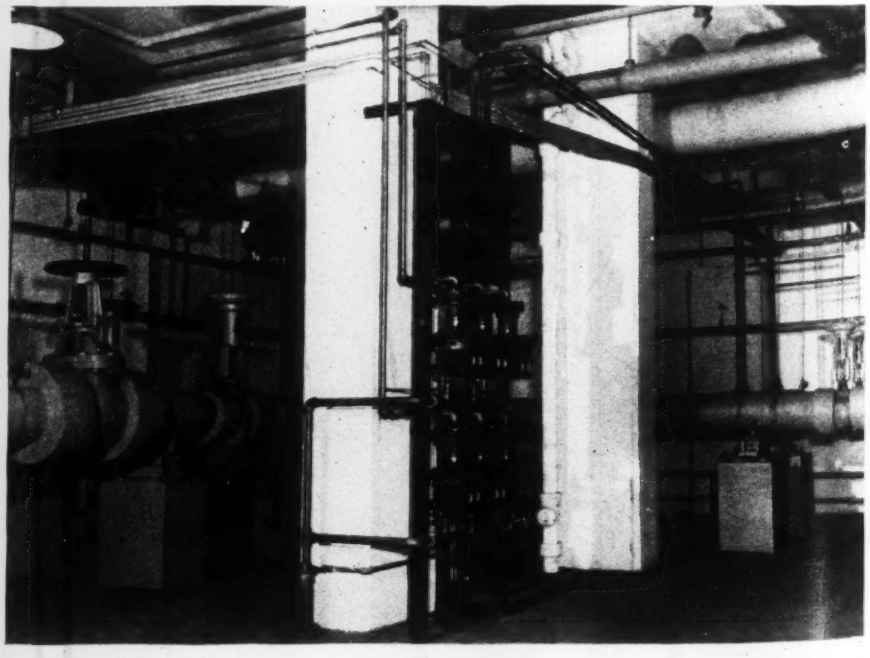
This is strikingly demonstrated in the boiler house. Practically every piece of equipment requiring frequent attention is located on the main floor and in such a position relative to the main control board that one man on duty can operate the entire plant and still remain at all times within a few feet of his normal operating station. Reflected over a period of 25 or more years, the added investment should be well justified.

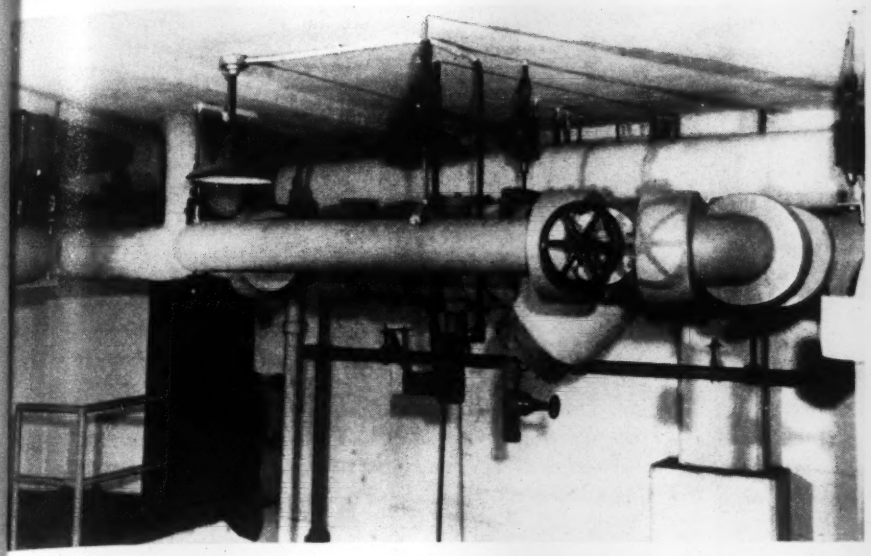
The 125 lb underground piping between the boiler house and the primary control rooms is laid in tile conduit and insulated with 1½ in. 85 percent magnesia covering. These mains were sized primarily on a velocity basis although the overall pressure drop was calculated in every case and found not to exceed 10 lb. No main is larger than 8 in. and velocities up to 10,000 fpm are used, with lower velocities in the smaller sizes. All mains grade uniformly down to the primary control rooms where they are dripped through traps into flash tanks. The flash steam is connected to the 10 lb header. Reduction to 10 lb is made in two stages.

Pump discharge lines are generally in the same conduits with the steam mains and are not covered. If in separate trenches, these lines are covered with 85 percent magnesia of standard thickness.

All 10, 50, and 100 lb drips are taken to condensate pumps in the primary control rooms. These pumps also receive the discharge

A primary control station showing the high pressure reducing valves, control and gage board, and vibration isolating supports. This station is in the basement of one of the 13 story buildings





Spring isolating hangers in a control room to stop transmission of vibration due to steam flow to the building structure

from several vacuum pumps in the various zones and send the entire quantity back to the surge tank in the boiler house.

To eliminate the transmission of steam and pump noise into tenant-occupied spaces, all piping in primary control rooms in the apartment houses is hung on spring type isolating hangers. Pumps are mounted on concrete blocks which in turn are set into a cork lined recess in a concrete base, and all piping to the pumps has flexible connections. Primary control rooms have hung ceilings of sound absorbing materials and fans to cool the space between this ceiling and the floor above.

Downfeed Riser Heating System

Since the decision had already been made to use steam and either radiators or convectors for heating, with proper means for controlling the heat, the next phase of the problem was primarily the method of piping. For the two 13 story buildings there was not much doubt that the "Metro" method of piping, as used in similar investment jobs, should be used here and this carried along with it the method of control by subatmospheric steam.

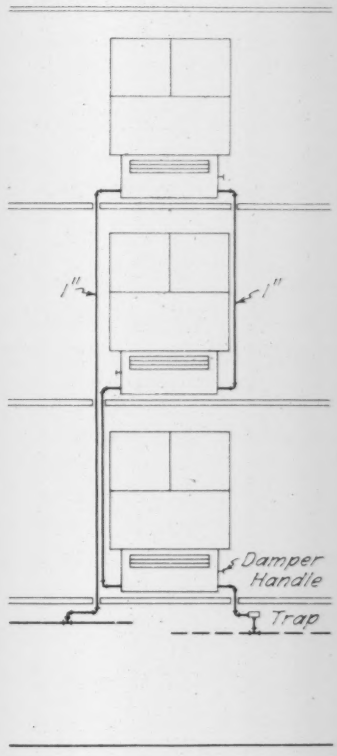
This method of piping involves the use of a single riser passing down through a number of typical overlying rooms, this riser being offset in each room and these offsets being the heating elements of convectors of special design. This riser is supplied with steam at the top floor from an adjacent bathroom or kitchen heat riser. It is dripped through a single float and thermostatic trap in the basement. The heat risers are usually 2 or 2½ in. for heating effect and are amply large to supply steam to one or more of the 1½ in. downfeed risers.

It was a natural sequence that consideration should be given to this same method of piping in the two and three story buildings. Here we have what might be called "horizontal" rather than "vertical" distribution—long mains and short risers as compared with short mains and long (high) risers. With horizontal distribution, the pressure loss in the mains is high and in the risers low, whereas the reverse is true with vertical distribution. The cost of the mains becomes the vital factor and, to keep this cost as low as possible, it is necessary to elevate the pressure drop and use small mains. Since the total pressure drop (including mains, risers, radiators, and return lines) is the final deciding factor, anything which reduces the pressure loss in the risers and radiators helps to cut the sizes of the mains. It was quite evident that the same riser piping scheme as used in the 13 story buildings would give an exceptionally small pressure drop through the risers, due to the use of 1¼ in. pipe for the heating elements of the convectors, the elimination of small pipe and fittings for radiator branches, and the use of a single trap for a group of convectors.

From an installation viewpoint, a most important advantage is the elimination of radiator branches. With concrete floor slabs and masonry walls it would have been necessary to hang these branches on the ceiling and fur them in (which is costly), fur out the walls to get room for them behind the plaster (also costly and wasteful of space), or run them exposed along the baseboard (which is unsightly). With solid partition walls there is no space for risers and these would have to be located in the corners of the rooms and left exposed or furred in. As opposed to all this, the small downfeed risers alongside the windows, left exposed and painted the same color as the walls, with the usual window drapes, are not noticeable and in fact so blend into the background as to become practically invisible.

From the maintenance point of view, the absence of traps and valves in occupied spaces means that tenants do not have to be disturbed to service these devices. All such service work can be scheduled by the management without reference to the tenants and confined to basement areas.

The downfeed riser and convector arrangement as used in the three story buildings



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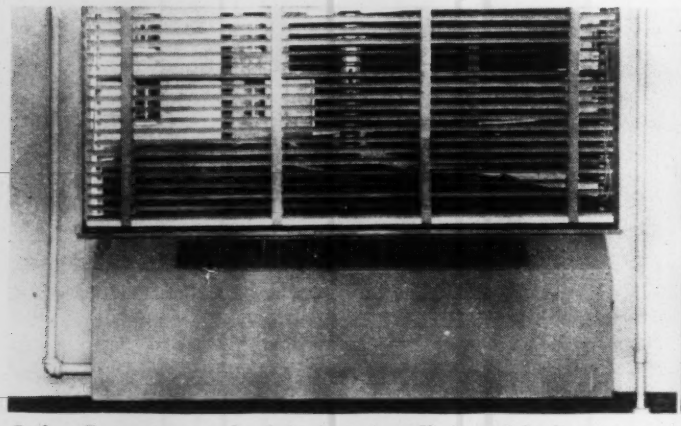

Left—**Convector and piping as installed and before occupancy. This one is on the first floor of a two story building, and the upfeed riser to the second floor convector is on the right.** *Right*—**An occupied room, showing the appearance of the convector and how the riser piping is concealed from view by the drapes**

For all these reasons, this method of piping was adopted for the entire project. Since convectors are required for this method of piping, the question of radiators or convectors was settled too.

Because these buildings are only two and three stories high, the heat risers were not used to feed steam to the tops of the downfeed risers. To do that would have used practically as much lateral pipe on the top floor as would be required for a heat riser of the loop type. The downfeed risers are mainly only 1 in. Hence, it was decided to depart from the design used in the other buildings and run a separate riser up alongside each tier of windows to the inlet end of the convector on the top floor. The risers are sleeved through the spandrel beams.

All bathrooms are heated by risers, as are all kitchens, except those having outside doors where the added heat loss requires the use of convectors.

Subatmospheric Steam for Control

To control the heat in the buildings with this method of piping, subatmospheric steam was necessary. Any other method of control would have required orifice plates which could not be used under this condition. Any intermittent control was obviously impossible for a job like this. The use of orifice plates would in any case defeat the problem of small mains with low overall pressure drop by introducing an artificial drop through the plate at each convector. With an orifice system it is also impossible to control the heat risers except by the use of sleeves to distribute the steam evenly along the entire length of the riser.

Steam mains were sized for a pressure drop of 1 lb with steam entering the main at 2 lb pressure, this drop being calculated from the control valve to the extreme end of the longest main. It was then contemplated to vary the pressure in the main by the automatic positioning of the control valve from 2 lb down to around 24 in. vacuum. Tests on previous jobs showed that at high vacuum this pressure drop would decrease, and that it would not have enough effect on room temperatures to justify using larger mains. The pressure drop through the loops from the steam main through three convectors to the return main was considered negligible and is actually in the order of 1/10 to 2/10 in. of mercury.

Whereas the maximum vacuum will not result in a sufficient reduction in heating effect of the convectors to prevent overheating with outside temperature above 55 deg, it is expected that as temperatures approach 60 the operator in the boiler room can easily shut the heat off manually from the control board during the middle of the day.

Since any attempt to zone these small buildings for exposure would have involved prohibitive equipment expense, the only consideration given to this was in the application of an exposure factor in calculating the convector capacities.

Grading Steam and Return Mains

When locating the steam mains it is not necessary that there be a continuous and uninterrupted grade from start to finish. In fact, the mains may be run without regard to elevation and may be backgraded if necessary for short runs as between buildings, provided that all low points can be dripped into a return main and that there is a proper grade between drip points.

It is necessary, of course, that the return mains shall always pitch down to the vacuum pump without lifts. To avoid deep trenches, these return mains do not always follow or parallel the steam mains but where topography made it expedient to do so they were run independently and in various directions. The vacuum pumps are always located at the low point in the zone, regardless of where such low point may be, although the attempt was made to keep the pumps at the opposite ends from the control valves to help cool the condensate.

Air Conditioning Btu's Metered and Sold

The air conditioning of the stores and the theater involves the use of several novel methods.

To begin with, the whole scheme is unique. Probably nowhere else in this country is refrigeration produced, distributed, and sold on a metered Btu basis on a commercial scale. The refrigeration plant is attached to the central boiler plant and is operated by the same men. There are two 600 ton "Freon" centrifugal compressors each driven by a 600 hp, 4160 volt, three phase, 60 cycle motor through reduction gears. Condenser water is obtained from two wells about 100 ft deep at a fairly constant annual temperature of about 52 F. The pump for each well has a capacity of 500 gpm.

[*Concluded on page 76*]

LET'S GO TO WORK!

ON THE SHOULDERS of the salesman today rest not only the security of his own business but actually the economic future of the whole world. You say I am spreading it on a bit thick? Wait until I show how I arrive at this thought, and you may not be too much at variance with it.

Understand, first of all, what kind of salesman I have in mind. I am not thinking of that noisy but small minority of high pressure spellbinders who exist more in the modern novel and on the stage than in real life. I am thinking about the vast majority of salesmen—the honest, hard-working (at least, they used to be hard-working) salesmen who do not need high pressure—who do not need it for the simple reason that they have something *real* to sell.

As a matter of fact, the kind of salesman I am thinking about may or may not be known as a salesman. He may be called a contractor, a dealer, a merchant, a wholesaler, an architect, an engineer, or an advertising man. He is simply the fellow whose job it is to present facts to people about products and services they *need*.

If he has something that people really need—something that will bring them happiness, or comfort, or dollars, or any combination of these—he doesn't have to be a glib personality-boy to make a complete success. All he needs is to be a devoted student of his business or product. If he is a truly conscientious student, he will inevitably soak up knowledge of his business or product that will fire him with blazing enthusiasm for it. Out of that genuine enthusiasm will come an ability to present his facts in the honest and sincere way which rarely fails to convince the prospect. Thinking back over the times you have bought, isn't it a fact that an ounce of sincerity has been worth a ton of ballyhoo?

Yes, it is this honest fellow with an honest case to present—this salesman either in name or in kind—who, in my humble opinion, holds in his grasp more than any other man today the key to our economic future. He, in my opinion, is the man of the hour—the fellow who more than any other has the power, if he will make full use of it, to keep the wheels of prosperity turning.

Sales Make Jobs Make Buyers

Every time this fellow makes a sale he makes jobs for the men in the plants that produce the goods he sells. Thus he keeps men working, and these employed men—these men with dollars in their pockets—provide a ready market for the sale of other goods that in turn put dollars into the pockets of still other men.

I know there's nothing new about this. It's simply the time-honored cycle called prosperity. Graphs and still more graphs have presented it. Political camps have argued and kicked around all angles of it. But all graphs, all politicos, all isms, agree that the optimum condition, however it is achieved, is simply the happy cycle of people working . . . therefore buying . . . therefore keeping right on working and buying.

Why has that happy cycle, despite its many breakdowns, run more smoothly in the U.S. than in any other country on the globe? We give a lot of reasons for it, and of course there *are* a lot of reasons. But is there any one factor as basic as salesmanship? Go over the history of our industrial giants. Contributing tremendously to their success, of course, are the inventive genius and technological developments of which we are so justly proud. But what got them going? What kept them growing? The answer, you will discover, is salesmanship—the salesmanship of men with contagious enthusiasm born of sincere belief in their projects.

The "Technocrats" of not too many years ago said mechanization would put men out of work. But salesmen said, no . . . and made it stick! No need to cringe at the spectre of unemployment if the salesman keeps selling! No need to worry about fields for honest selling if men are working! How I wish the salesmen of America could realize their individual responsibilities in keeping that cycle going!

We Are in a Transition Period

At no time in our economic history has that responsibility been more clearly defined than it is today. We are in a transition period from the abnormal buying of soul-

E. N. McDONNELL, president of McDonnell & Miller, Inc., Chicago, feels that on the shoulders of today's salesman rest not only the security of his own business but the economic future of the world. The kind of salesman he is thinking of may or may not be known as a salesman—he may be a contractor, an engineer, an architect, a dealer, a wholesaler, a merchant, or an advertising man. . . . Let's equip ourselves in mind and spirit to sell, and then let's go to work!

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Sales make jobs . . . . and buyers

searing war years to what is currently forecast as anything from a plateau of "normalcy" to a chasm of hard times, depending entirely on the degree of optimism of the forecaster. Are the familiar charts that are said to prove an inexorable swing from snowcapped peaks of prosperity to bottomless pits of poverty all they pretend to be? I realize there is a convincing repetition of cycles in these graphs, but isn't it true that looking back we find the peaks and valleys to be largely psychological? Acres do not lose their fertility in depressions. Men and machinery do not lose their productive capacity. Natural resources do not disappear. What changes is just one thing: the human mind. Men lose their spirit. The recession appears and feeds on itself. The cycle goes into reverse.

That reverse cycle is the condition we always seek to correct. We try so-called "controls"—write them into our statutes. I have no fight with floors and ceilings and subsidies and parities and minimums. But are these the real answer? They are, at best, only part of the answer. The best control is human spirit. And the men who can supply that spirit best are the salesmen of the U.S.A. If all the men who have something real and needed to sell would double their selling effort, they would start a chain of prosperity that would put to shame the wildest imaginings of the late and very much deluded pyramid clubbers.

"Your Flirting Days Are Over"

Some there are who now say that salesmen in general, having lived too long on the fat, have become flabby and spoiled and indolent. Well . . . why shouldn't they? But, by the same token, why shouldn't they see the error of their ways before it is too late? In the words of the poet, "Your flirting days are over and you've got to settle down." Hard times are not here, but soft times are *gone!*

Let's pull ourselves up to the full stature of our responsibility as salesmen. Let's study our businesses until we are saturated with honest enthusiasm for the things we have to sell. Let's equip ourselves, in both mind and spirit, to sell!

Having done that, let's work *hard*. It's the hard-working—not the hard-hitting—salesman that leads the pack. Let's enlist in a peacetime legion of happy warriors to crusade for sales of needed goods. Let's make *our* industry an inspiration for *all* industries. Let's go to work!

NEW YORK LIFE PROJECT

[*Concluded from page 74*]

All condenser water is returned to two diffusion wells so located that the discharged water flows away from the supply wells. The water is metered on both the supply and discharge sides.

Chilled water will leave the plant at 45 deg and will be pumped into a 10 in. main by means of three pumps having a combined capacity of 2000 gpm and operating against a total dynamic head of 100 lb. The 10 in. line is underground in an insulated conduit and runs about 1200 ft before the first tap is taken off. Thereafter, there are connections provided for each store. All told, there is about 1½ miles of chilled water piping. The return main is 12 in. and is not insulated but is covered with bitumastic wrapping. The return main is larger than the supply main to enable proper pressure differentials being established at each connection and to reduce the overall pressure loss.

The theater and the larger stores have conventional air conditioning systems with steam reheating coils for humidity control. Separate steam coils are used for winter heating and ventilation. The theater and department store each have a Btu totalizing and recording meter in which the flow of water in gpm and the temperature difference between supply and return water are measured and the result in Btu is recorded and totalized. These users are then charged for cooling at a rate per Btu actually used. Smaller users are charged at a flat rate. A similar meter is installed at the refrigeration plant to show the Btu sent out so that a close check can be kept on the performance of the entire system.

The two 13 story buildings have interior corridors and a few interior bathrooms. These are mechanically ventilated as required by the New York city code. Laundries and garages are fully ventilated. Food stores are especially ventilated to prevent odors. Stores which do not presently have air conditioning have ventilating systems so arranged as to be readily converted to cooling at a later date.

The architects for the whole project are Voorhees, Walker, Foley and Smith, working with the New York Life housing department architect and engineer. The consulting mechanical engineers are Meyer, Strong & Jones. The general contractor is the George A. Fuller Co. and the heating, ventilation, refrigeration, plumbing, and most of the air conditioning are being installed by J. L. Murphy, Inc. All are of New York City.

Electric Storage Heating Serves New Oregon School

The Cascade Locks school, with the Bridge of the Gods and the Oregon side of the Columbia Gorge in the background. The electric heat storage system performed with satisfaction last winter during the coldest weather experienced since 1932

W. BRUCE MORRISON, consulting engineer, Portland, Ore., takes us through the "engineering reasoning" underlying the selection of storage heating with offpeak electricity for the new Cascade Locks school, which met the low temperatures last winter with satisfaction. There is a panel heating system for the classrooms with capacity for furnishing the full heat requirements less about one-half of the ventilation or infiltration load. The heating and ventilating unit for the gymnasium has hot water supplied to its coil, with the control arranged to mix a certain amount of recirculated water and to maintain a fixed maximum flow of water through the coil at all times

WHEN THE COUNTY unit schoolboard of Hood River County was studying the preliminary plans for a combined grade and high school to be erected at Cascade Locks, the subject of electric heat was raised.

Cascade Locks is on the Oregon shore of the Columbia River immediately adjacent to the Bonneville dam, which has an electrical generating capacity in excess of 500,000 kva. The Bonneville Power Authority supplies power for the Cascade Locks municipal system, which had a maximum peak load in January 1948 of approximately 1150 kw.

This municipal system purchases power on a kilowatt-year basis from the power authority. The highest peak load in any one month of 12 determines the billing for that month and the following 11 months unless the peak is exceeded; the new peak then determines the basis for the ensuing 11 billings. Any electrical energy which is used at a time and in quantities that will not raise the peak load costs the municipality nothing.

Complete Study of Offpeak Electricity

At the school board's request, the architects, Jack D. Annand and Rowe D. Kennedy, Ray Preston, the electrical engineer, and the author made a complete study of the feasibility of using offpeak electrical energy for heating the school. This report was furnished complete with a comparison of estimated first costs and estimates of yearly fuel consumption for both No. 5 fuel oil (Pacific specification No. 300) and electric heat storage. An explanation of the heating analysis and estimated fuel costs follows:

The total heat loss of the school with a 70 F temperature difference inside to outside is 544,000 Btu per hr, with projected expansion which will increase the heat requirements 180,000 Btu per hr. The combination gymnasium, cafeteria, and homemaking building has a total heat requirement of 320,000 Btu per hr at a 70 F temperature difference.

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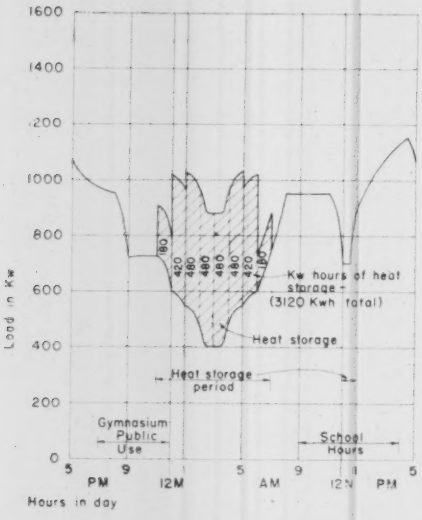
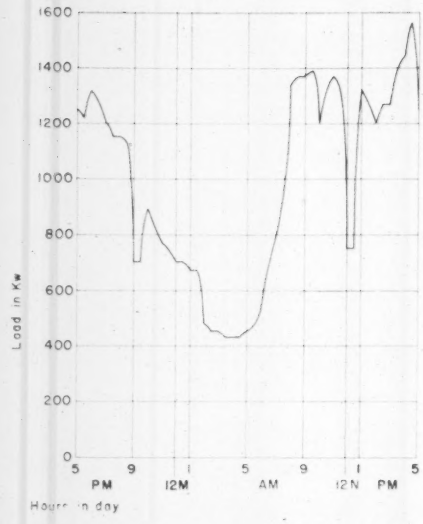
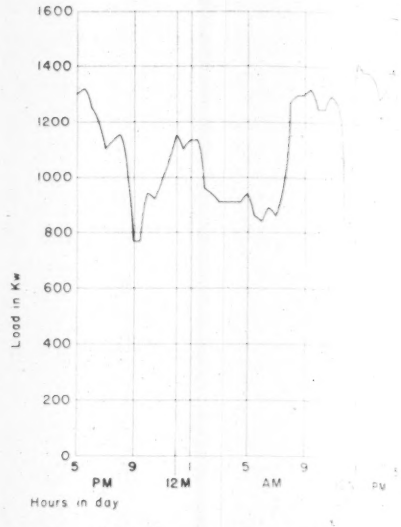


Left—**Average demand curve for January 1948 for the town of Cascade Locks with superimposed proposed maximum offpeak school heating load. Total heat storage is 3120 kwhr**



Center—**Power consumption curve for November 15-16, 1948, before school was in operation. This curve was compiled from Bonneville Power Authority demand meter records**



Right—**This curve shows the power consumption for December 7-8, 1948, after the school system was in operation. It was also compiled from Bonneville Power Authority records**

The total of present and future estimated heating requirements is 1,044,000 Btu per hr at a temperature difference between outside and inside temperature of 70 F. On any day that maximum heat will be required, it was assumed that enough incandescent lighting will be used to reduce the maximum heat demand to 950,000 Btu per hr. The school is in use from 9:00 a.m. to 4:00 p.m., a total of seven hours, to which should be added four hours for pickup or warming the building with the system selected. This allowance for pickup permits starting and warming the system at 5:00 a.m. or earlier, which assures a warm floor slab and heated piping system before the electric heaters are turned off.

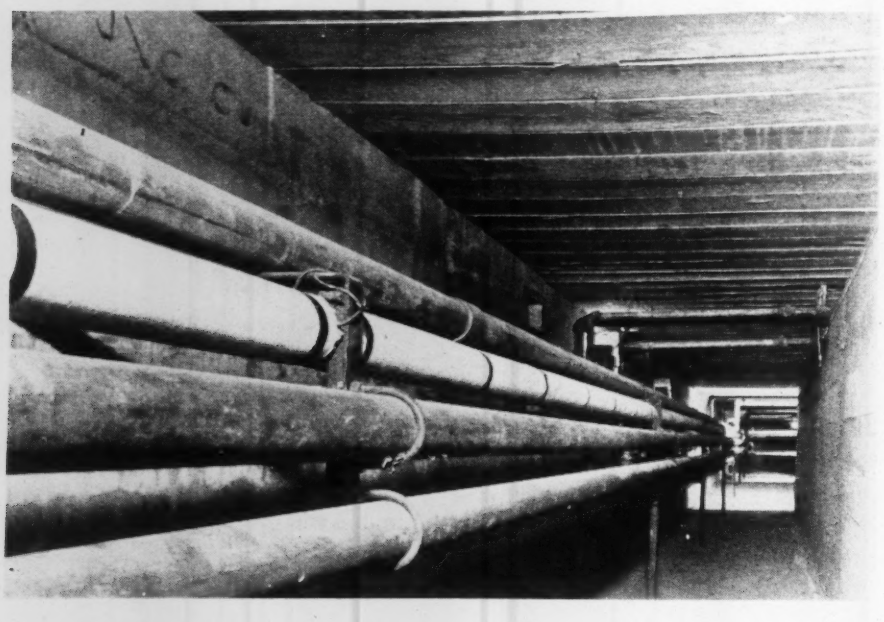
Assuming a 4 hr pickup at maximum demand, the total heat requirement is: 950,000 Btu per hr × 11 hr (7 hr use plus 4 hr pickup) = 10,450,000 Btu. The total kw heat storage required is: 10,450,000 Btu ÷ 3412 Btu per kwhr = 3060 kwhr.

An accompanying chart shows the average demand curve in January 1948 for the town of Cascade Locks together with the superimposed proposed operation of heaters for the heat storage period. The total heat storage without utilizing the noon dip is approximately 3120 kwhr.

The estimated monthly kilowatt requirements and oil requirements for the present building, based on an overall seasonal oil efficiency of 60 percent and an electric efficiency of 95 percent, are shown in the following tabulation:

Month	Kwhr	Oil, gal
September	12,240	530
October	33,600	1,350
November	62,000	2,480
December	83,360	3,700
January	89,200	3,570
February	71,040	2,840
March	61,280	2,460
April	42,480	1,690
May	27,200	1,080
Total	482,400	19,700

Air to each classroom is supplied through a suitable dampered opening from the pipe tunnel, which does double duty as a supply duct



Assuming electricity at 0.4 cents per kwhr and fuel oil at 8.5 cents per gal f.o.b. Cascade Locks, the cost of electric heating is $1930 per year as compared with oil at $1670 per year. At the time the installation was made, it was thought that the price of electricity might be lowered and that oil might well continue to increase in cost.

As of April 15, 1949, the price of fuel oil had dropped to 7.5 cents per gal and the municipality was considering revising the electric rate to 0.3 cents per kwhr. With these figures, the oil would cost $1477 per year and electricity for heating would cost $1447.

It should be understood that heat storage installations of this kind cannot be generally used, because it would take but a very few installations to change the peak load from

day to night—as witness the leveling off of the night valley or dip obtained by the installation of a heat storage unit for this one building in the community as shown by the actual curves of power consumption in the accompanying charts. One of them shows the load for November 15 at 5:00 p.m. to November 16 at 5:00 p.m. before the school was in operation. The other shows the load for December 7 at 5:00 p.m. to December 8 at 5:00 p.m. after the electric storage heating system was placed in operation.

Air from this typical lower grade classroom is vented through the cloakroom, thus drying wet outer clothing

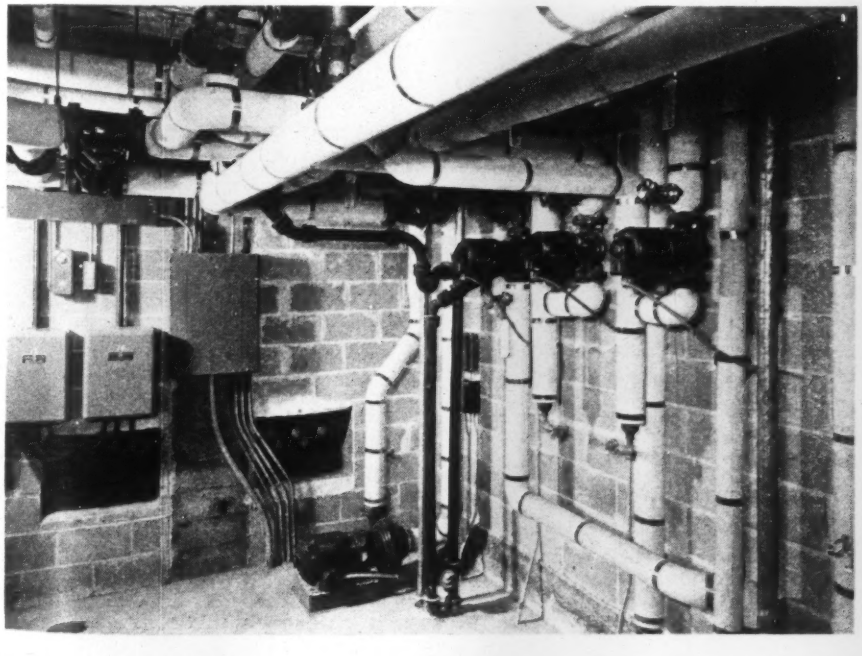
Panel Heating for Classrooms

The heating system which was selected, following discussion with the architects and the schoolboard, was a panel heating system for the classrooms with sufficient capacity for furnishing the full heat requirements of the rooms less approximately one-half of the ventilation or infiltration load, which is furnished by the outdoor tempered air supplied to each classroom.

Outdoor air in the quantity of 25 cfm per pupil is supplied to each classroom from a central fan and heating unit which discharges the air into the pipe tunnel, which does double duty as a supply duct. Air to each classroom is then supplied through a suitable dampered opening from the pipe tunnel, distributing into the classrooms through four-way adjustable air conditioning type grilles. The present air circulation is 9000 cfm, and with the future addition it will be 12,000 cfm.

To provide more flexibility in the system and to permit operating the ventilating system at outside temperatures below design conditions, the classroom outdoor air intake has a motorized multi-louver damper, and there is a recirculating air opening in the hallway with a similar damper to permit variation in the outside air quantity during extremely cold weather. Cold weather with temperatures below freezing is usually of short duration and will not exceed two or three weeks in the average winter. At all outside temperatures above 32 F, the ventilating system is intended and designed to take 100 percent outside air.

Four circulators are used—from left to right they are the main panel pump; the school ventilation pump; the cafeteria, home-making, showers, and manual training zone pump; and the gymnasium heating pump. Openings for six future electric heaters may be seen above the circulator on the floor



Heating, Ventilating Unit for Gym

The heating and ventilating unit for the gymnasium consists of a fan and a heating coil with outdoor air and recirculated air dampers. This unit provides practically all ventilation air to the space inasmuch as the gymnasium has no windows.

The controls on this unit provide for all recirculated air up to temperatures of approximately 65 F at which time the outside air damper admits outdoor air in increasing amounts until it is wide open at a room temperature of approximately 70 F.

Hot water is supplied to the coil, with a control arranged to mix a certain amount of recirculated water and maintain a fixed maximum flow through the coil at all times. The use of recirculated water reduces the amount of hot water drawn from the tank and assures less turbulence within the tank—as the water which returns to the tank is held to a minimum.

Control of each of the two panel heating zones consists of an out-

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door control which operates a three-way mixing valve to provide the desired temperature to the panel heating system. The water temperature increases as the outdoor temperature decreases. To prevent overheating from sun effect, changes in wind direction, and internal heat variations, each room or area has a limit thermostat which closes the motorized valve in the pipe supplying the floor panels in that area.

Study and analysis of the pickup and continuous heating load indicates that utilization of the thermal heat storage in a concrete floor slab heating system would actually reduce the amount of heat storage necessary for the system; that is, if the outdoor temperature increased during the day, as is the normal condition.

The controls drop the panel supply water temperature approximately 1 F for each 1.5 F increase in outside temperature. A 9 F outside temperature rise drops the panel supply temperature 6 F. A 6 F drop in panel supply temperature will give a corresponding drop in average concrete mass temperature of 3 F. These approximate figures do not apply to floor surface temperatures.

The total thermal heat storage of the concrete floor slab (assuming an average floor slab temperature drop of 3 F being available and with an average thickness of 4 in. over the classroom and basement area) available to heat the space is: 14,000 sq ft × ⅓ ft × 3 F × 144 lb per cu ft × 0.156 Btu per lb per F = 315,000 Btu.

This indicates that approximately 3 percent of the required heat storage might be taken care of by thermal heat storage in the floor slab. Disregarding this, and assuming the total heat requirements of 10,450,000 Btu to be furnished by water storage with an assumed available temperature difference of 90 F, we find a total storage of: 10,450,000 ÷ 90 = 116,100 lb of water will be required. Dividing this by 8.34 lb per gal gives total water storage requirements of 14,000 gal. To allow a factor of safety and to provide sufficient heat for night gymnasium use without noon operation of the heaters, a total heat storage of 16,000 gal was provided. This heat storage was divided into 10,000 gal for the classroom and cafeteria zones, and 6000 gal for the classroom ventilating and gymnasium heating and ventilating unit. An actual breakdown of heat requirements indicates a panel heating storage of 9000 gal and a ventilating and gymnasium storage of 4000 gal as the minimum requirements. Additional storage was provided because the tanks will not heat completely to the bottom.

Considerable study was made of the water storage tank construction so as to assure as complete heating of water throughout the tank as could be obtained and also to maintain a high temperature in the upper part of the tank with a low temperature at the bottom. It was hoped that it might even be possible to continue to supply 200 to 220 F water from the top of the tank with the tank nearly full of 90 to 120 F water from the returns, and it has been found in practice that the hot water supply continues at 200 F or higher.

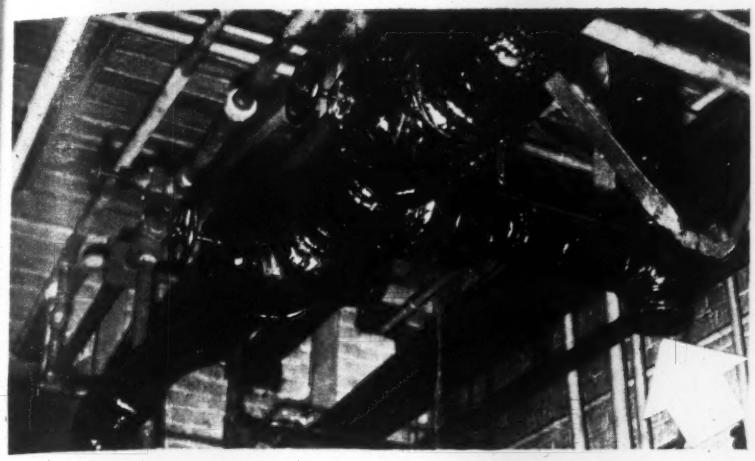
Four openings are provided for the hot water supply and two openings with baffles over them for the returns, the purpose of the baffles being to distribute the return water along the bottom of the tank. The insertion type electric heaters are set as low as possible in an effort to make full use of the storage. To permit greater flexibility, the piping is arranged so that either tank can be used on both systems or both tanks can be used on either system.

The electric controls for the tanks are arranged so that in mild weather only a limited number of heaters are actuated, thus providing a more steady use of current.

The effect of the outdoor thermostats in limiting the number of heaters can be checked by comparing the accompanying demand curve for November 15-16, 1948, with the curve for December 7-8, wherein the increment of power used by the electric heating system was approximately steady at 400 kw. The heaters appear to have cut off about 5:30 a.m., which would indicate that the tank temperature setting was reached. The outdoor temperature on December 8 did not drop below a minimum of 32 F. At this temperature the outdoor thermostats permitted not more than 360 kw of heaters to come on.

The school was occupied January 15, 1949, and, although not completely finished, was used for classes throughout the coldest weather which has been experienced in this locality since 1932. Minimum temperatures as low as plus 5 F were recorded. The personnel of the school report that adequate temperatures were maintained in spite of the fact that final adjustments had not been completed.

The 10,000 gal storage tank is immediately behind the pumice block wall to the right, and the 6000 gal tank is behind the wall to the left



GEORGE HOLMAN, refrigeration engineer, discusses preliminary planning and erection procedure for the smaller piping modernization project, where the cost of extensive paper work would be out of proportion to the total job cost. He uses as an example a new pipe line installed at a packing company's plant

The machine room end of the pipe line, just after corking over. At the extreme right is the tee into which a sludge and sediment trap was screwed—and later removed—as described in the text

How to Plan Erection of Small Piping Job

WHEN INSTALLING new pipe lines, or when making alterations in old but extensive piping systems, prints or working diagrams, together with specifications of materials and a detailed account of the service the new line is expected to fill, are generally prepared. Everything is worked out on paper well in advance of the job, and there is little opportunity for errors, delays, or other interruptions to interfere with timely and satisfactory completion of the work.

On small or medium sized projects, however, extensive paper work may add expense all out of proportion to the other costs of the work. Just what percent of the entire cost of a job should be set aside for planning may be a debatable question. Certainly, time and money can be saved by using as little paper work as possible. Yet, in almost every instance, the simple act of setting dimensions and other data down on paper gives a clearer view of what is to be done, as well as the best methods of doing it.

While every engineer, contractor, or pipefitter has his own means and methods of planning and estimating small or replacement piping jobs, there must be of necessity points of similarity relating them all. Because every piping system has characteristics peculiar to itself, these common means and methods cannot be reduced to a definite procedure or routine. However, common essentials can be pointed up by setting down here the means and methods used by the author on one specific job.

For several years, a packing company made changes in its refrigeration system in such manner that a second story manifold connection of evaporators and an outside vapor return line to two compressors were no longer necessary. Moreover, much of the insulation had fallen off these lines, and the pipes had been rendered dangerous by corrosion. A new line to supplant the old one was planned, but had been long deferred because of the pipe shortage.

Preliminary Notes for Installing Line

When the new pipe became available, the plant was visited to gather the necessary data for installing the new line. The first move was to draw the environs of the line; that is, the space enclosing it. The following notes were made at random:

1) New line must begin at point best suited for juncture of various branches from evaporators. This will be at point in cutting room opposite door into holding room.

2) Line must run inside cutting room to outer storage wall. This is necessary to avoid conduits, keep the line as short as possible, and eliminate passage of the line through one of the brick walls.

3) Line so run will be only half as long as present 2½ in. vapor return line, and will cut off at least 25 ft from each branch line from the evaporators. Two of these lines are 1 in. and two are 1¼ in. Total cross-sectional area of these lines is, roughly, $1\frac{1}{4} \times 1\frac{1}{4} \times 0.8^* \times 2 + 1 \times 1 \times 0.8 \times 2 = 4.1$ sq in. This is somewhat greater than the cross-sectional area of a 2 in. pipe.

4) Branches to the two compressors are 1¼ in. and 1½ in. pipes. The combined cross-sections of these two pipes total (again roughly) $1.25 \times 1.25 \times 0.8 + 1.5 \times 1.5 \times 0.8 = 3.01$ sq in. Thus, the cross-sectional area of a 2 in. pipe is fairly close to the combined cross-

* 0.8 = short practical equivalent of the constant 0.7854, or $\pi/4$. When calculating actual cross-section of standard pipe, the shorter form is more accurate than the longer.

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sections of a 1¼ in. and a 1½ in. pipe.

5) Without determining the quantity of ammonia evaporated, absolute velocity, or other positive factors, let's see whether or not 2 in. pipe can be used as the new line. What of pressure drop? Since resistance varies with the square of the velocity, what will this resistance amount to? There is no appreciable pressure drop in the present 2½ in. line, except when both compressors are operating.

6) A 2 in. pipe has, roughly, a cross-sectional area of 2 × 2 × 0.8, or 3.2 sq in. A 2½ in. pipe has an approximate cross-sectional area of 2.5 × 2.5 × 0.8, or 5 sq in. Comparing these pipe sizes, it may be noted that the velocity of the ammonia vapor at any given load will be inverse to the cross-sectional areas, or in the ratio of approximately 5 to 3. Thus, if the 2½ in. pipe line is supplanted by a 2 in. line, an assumed present velocity of 32 fps in the 2½ in. line will be succeeded by a velocity of 50 fps in the 2 in. line.

However, the resistance will be increased in smaller pipe in proportion to the squares of these values. That is, 32 × 32 = 1024 and 50 × 50 = 2500, or 2500 : 1024 : : 2½ : 1. Thus, for a given flow of vapor, resistance in the 2 in. pipe will be approximately 2½ times that in a 2½ in. pipe.

7) Since this resistance increase is only for a unit length, and since the new line is to be only one-half as long as the older and larger pipe, resistance for a 2 in. pipe will be only 2½ divided by 2, or 1.25 times that for the present line. The increase is thus only 25 percent.

8) Further, at least 25 ft will be cut off the 1 in. and 1¼ in. branch lines. It is safe to assume that the total reduction in resistance here will more than offset the increase in the main line. Therefore, 2 in. pipe may be used for this job.

9) Here are the measurements for the pipe line (Note: h = horizontal; v = vertical; NS = north-south; cL = center of ell; etc.):

a: 2′, 6″ h, NS, cT to cL.
b: 2′, 6″ v, cL to cL.
c: 8′, 4″ h, EW cL to wall.
d: 1′, 1″ h, EW through wall.
e: 18′, 6″ h, EW wall to cL—across sausage room.
f: 21′, 6″ h, NS cL to cutting room wall.
g: 0′, 7″ h, NS through wall.
h: 1′, 3″ v, cL to cL—riser to put line above tracks.
i: 28′, 3″ h, NS cL to c bullhead T.
j: 2′, 9″ h, EW cT to cT—through holding room door.
k: 0′, 6″ v, cT to cL—riser.
l: 3′, 9″ h, NS cL south to chill room wall.
m: 0′, 6″ h, NS through wall.
n: 1′, 3″ h, NS wall to cT.
o: 10′, 3″ h, NS cT to cT—chill room evaporators connect here.

10) Order 100 ft of 2 in. pipe, 20 ft of 1¼ in. pipe, and 20 ft of 1 in. pipe. If 100 ft is not enough, reduce to 1¼ in. at Item "o" above. Excess of smaller pipe will be used to replace part of old lines connecting the evaporators.

Advisory Erecting Procedure

11) Beginning at machine room. Let stand: Present 2½ in. parting tee, 30 in. NS horizontal run of 2½ in. pipe, and same size uplooking ell.

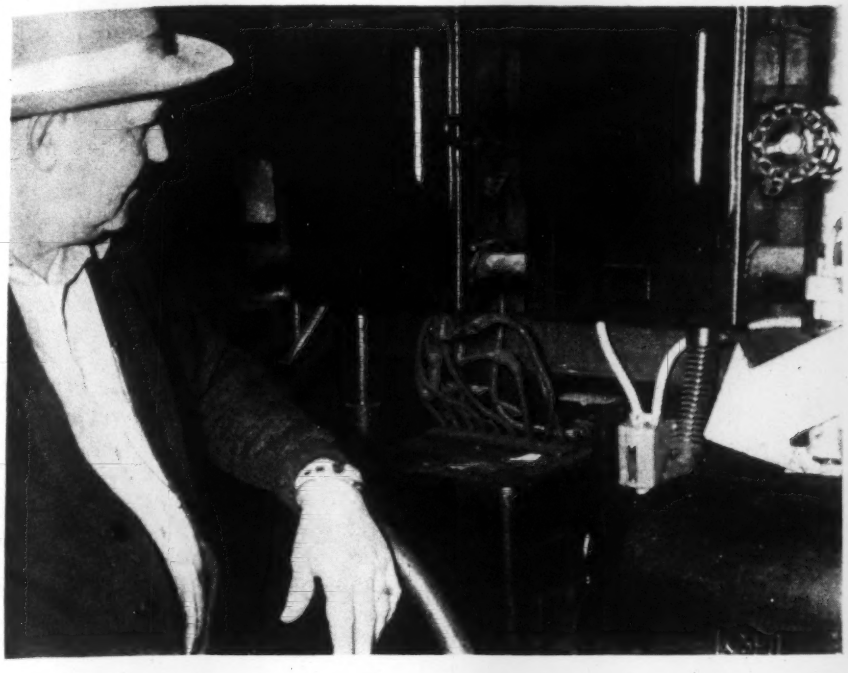
12) Plumb line shows that highest point for turning off new pipe line from old vertical line is 10 ft, 3 in. from machine room floor. A check through hot rooms to cutting room wall shows that new line at this level will clear other pipes, conduits, etc.

13) At 10 ft, 3 in. level, begin 1 ft from old return line with one half union on a full length of 2 in. pipe. Cut hole through wall for this pipe. A coupling needed to extend line to pilaster of wall between sausage and slaughtering rooms 27 ft, 11 in. EW from center of old return line to center of ell looking north. Fittings needed: one 2 in. union; one 2 in. coupling; one 2 in. ell.

14) Run 2 in. pipe north at same level 21 ft, 6 in. to wall and 7 in. through wall into uplooking ell. Insert 15 in. pipe as riser into ell again looking north. Run pipe along wall and anchored to I-beams above meat tracks 28 ft, 3 in. into a bullhead tee directly under present return line end. Fittings needed: two couplings; two ells; one tee, 2 in. × 1¼ in. × 2 in., or bush 2 in. × 2 in. × 2 in. to connect the cutting room evaporators. Also one 1¼ in. valve for the evaporator connections.

15) Remove present basement return line connections to cutting room line. Into west end of bullhead tee screw 2 ft, 9 in. piece of pipe to carry line into holding room through hole left by removal of basement return. Enlarge hole, if necessary, through wall. Screw on 2 in. tee looking up. Into center outlet of this tee, screw a long vertical nipple with ell on end looking south. Into end outlet of tee screw reducer, attach 1 in. valve with nipple, and through same size

The cutting room of the plant. The arrow points to some of the piping discussed in this article



If a plant can't be made wholly automatic, it should be made as automatic as possible. Here, the plant superintendent looks over a switch which shifts control of a master solenoid stop valve from one compressor to the other. Arrow points to solenoid stop valve switch

nipple connect holding room evaporators. Fittings needed: one tee, 2 in. × 2 in. × 2 in.; one bushing, 2 in. × 1¼ in.; one bushing 2 in. × 1 in.; one 2 in. ell.

16) Connect present basement return line to chill room return line, thus reversing flow of vapor temporarily from basement. This must be done in chill room. Move small liquid line there, if necessary. Fittings needed: 1 in. union; 1 in. ell; one ell 1 in. to 1¼ in.; 1¼ in. pipe 15 ft long. Two ½ in. ells, with union and nipples for changing liquid line.

17) With basement vapor line completely changed, enlarge hole in wall between holding room and chill room. Through this hole run 2 in. pipe and screw into south-looking ell of Item 15. Pipe length here almost 5 ft. Onto this pipe end screw 2 in. tee with bull end down. Tee to be 2 in. × 2 in. × 1 in., or 2 in. × 2 in. × 2 in. reduced. Connect basement return line at this point. Fittings needed: one 2 in. × 2 in. × 1 in. tee, or 2 in. × 2 in. × 2 in. with bushing 2 in. × 1 in.

18) Into tee of Item 17 screw approximately 10 ft of 2 in. pipe, with tee on end looking west. Plug line end and bush bull end to pick up present chill room evaporators. Fittings needed: one tee, 2 in. × 2 in. × 2 in. with bushing 2 in. × 1¼ in. and plug 2 in.

General: This ends line. Blow line thoroughly with compressed air before connecting evaporators and compressors. Let stand overnight under 150 psig air pressure. Test for leaks with soapy water under air, and with sulphur tapers and test papers after ammonia is admitted.

Final connections in machine room: Set up plumb line and line for string level. Make up other half of 2 in. union on a piece of pipe, mentioned in Item 13. Measure from face of union to center of old pipe line, and thread pipe end to bring new ell in alignment with old pipe. Measure vertically, and make up short piece of pipe with 2 in. ell on one end and 2½ in. × 2 in. bushing on other end for screwing into 2½ in. uplooking ell, mentioned in Item 11.

Order the following materials for new vapor return line:

100′ of 2″ heavy duty pipe.
20′ of 1¼″ heavy duty pipe.
5 each hd ells, 2″.
3 each hd couplings, 2″.
1 each union, hd 2″.
4 each tees, hd 2″ × 2″ × 2″, (to standardize).
1 each bushing 2½″ × 2″.
3 each bushings, 2″ × 1¼″.
1 each bushing, 2″ × 1″.
4 each nipples, 2″ hd.
1 each pipe cap, 2″ hd.
1 each pipe plug, 2″ hd.
3 each ammonia valves, 1¼″.
1 each ammonia valve, 1″.
3 each unions, 1¼″ hd.
1 each union, 1″ hd.
1 each ell 1¼″ × 1″, hd.
1 each ell, 1″.
2 each ells, ½″.
6 each nipples, ½″ short to very long.

Actual Erection Varied Somewhat

Unforeseen conditions often arise to prevent exact and proper carrying out of well made plans. In the erection of this ammonia vapor return line, several factors prevented installation according to the advisory procedure outlined above. The four most important ones were:

1) 2 in. heavy duty pipe ells could not be obtained.

2) 2 in. heavy duty pipe couplings could not be obtained.

3) The plant had to be kept under normal operating procedure, with few interruptions in plant activities and as little down time of compressors as possible.

4) Evaporators had no individual valves in the vapor outlets. In fact, there were only two shutoff valves in the whole of the return line outside the machine room. These were old, and when put to the test either did not hold at the seats or leaked ammonia through the stem packing. Each time any part of the system had to be opened, the whole system had to be pumped down.

The first problem was solved by substituting 45 deg ells for the 90 deg ells in some places and by plugged tees in others. The second problem was solved by using plugged tees and a union in place of unobtainable couplings. The third problem was solved in part by doing some of the essential work on Saturdays and Sundays, and after quitting time at the plant. Except by complete pumpdown, the fourth problem could not be solved without new valves ordered for the 1¼ in. manifold outlets from the evaporators, all of which failed to arrive until after the main return line had been completed.

Erection began on a Saturday morning. Information from the owner pointed up the fact that, although the chill room was empty, a full kill of beeves and hogs would

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Necessity of avoiding meat tracks and hangers presented a major problem, and made the use of light duty insulation necessary. The pipe had to be high enough above the tracks to permit the switches (such as the one at the top of photo) to open and close

be placed in it during each of the five working days from Monday through Friday. These carcasses would require near capacity refrigeration and be in the way of the workmen erecting the pipe. In turn, the workmen would interfere with the activities of butchers and meat cutters. Obviously, the work in that room could be done better and faster if done with the room empty; that is, at once. The erecting procedure outlined as advisory was immediately reversed, except for final connections.

Since the manifold receiving vapor from the four chill room evaporators had been installed high enough to clear all meat tracks, three 2 in. pipe hangers were hung at this level in the north-south direction along the east chill room wall. As given in Item 18 of the advisory erecting procedure, a 10 ft length of 2 in. pipe was made up, with west-looking tee in line at south end and down-looking tee at north end. Both tees were plugged, the north end temporarily, the south end permanently.

The vertical 1 in. vapor return line from the basement evaporators was opened at a union, and the end of pipe connecting it with the cutting room evaporators capped off. The pipe from the basement manifold, however, was connected by union, ells, nipples, valve, and 2 in. × 1 in. bushing to the down-looking tee mentioned above. The 1¼ in. manifold of the chill room evaporators was opened at a union, and remade with an east-looking 1¼ in. tee in line with the west-looking tee at the end of the new 2 in. vapor return line. These tees were connected with 1¼ in. pipe, union, and 2 in. × 1¼ in. bushing. Some trouble could have been avoided if a 1¼ in. valve had been available to insert at this point. Temporarily, this section of the line served as a manifold through which the vapor from the basement reached the old return line through the branch from the chill room.

On the second day, however, the holding room evaporators were joined to the new line. From this point on, it was decided to connect all evaporators before making any attempt to erect the line through the hot rooms. This was done, and the cold room section of the line completed to a tee looking south in the cutting room. Final erection was fast and simple, since the remainder of the line consisted for the most part of three full sections of pipe reaching through a union, two 45 deg ells and a tee to a tee coupling within 6 ft of the old line inside the machine room.

At this point the tee was plugged, and the entire section of line allowed to stand overnight under operating suction pressure of ammonia. Since the line was dead-ended, there was of course no ammonia flow through it. In the morning, the entire system was pumped down, the smaller compressor reversed, and the line put under 10 psig air pressure, by pumping through the old line and evaporators. Standing behind the tee end, the engineer unscrewed the end plug by holding it with both hands, and permitted the air to escape through the new line. This practical procedure was repeated several times, at pressures of 15, 20 and 25 psig, thus sweeping out rust, die clippings, scale, and litharge left in the pipe after erection.

When making final connections a short piece of pipe was screwed into the last tee, and capped for a sediment trap. When taken out before covering the line with cork this trap was found to contain five die clippings, two pieces of litharge, rust sediment, traces of oil, and more than a pint of water left when the charge of old ammonia was pumped out.

WORLD WAR II COST RISE LESS THAN WORLD WAR I

The cost of all types of construction has risen less in the period during and after World War II than in the comparable period of the first world war, according to the Construction Industry Information Committee.

"Although the building industry has been subjected since 1939 to the most violent increases in demand in its history, the relative rise in construction costs during the nine-year period through 1948 has been 13 percent less than in the shorter period from 1914 to 1920, according to the Department of Commerce composite of indexes which reflect construction costs," the committee said.

"The rise from 1939 through 1948 was 112 percent for all types of construction, as compared with an increase of 128 percent in the 1914-20 period.

"Moreover, housing costs, which have been particularly subject to inflationary pressures, have held rather well in line with construction costs as a whole. The rise from 1939-1948 was 114 percent compared with 128 percent for the 1914-1920 period, according to the Boeckh index of residential construction costs."

Photo Studios Need Conditioning for Both Processing and Comfort

E. E. HERBACEK, secretary and chief engineer of the Spencer Air Conditioning Co., Minneapolis, points out that commercial photographic laboratories and studios need controlled temperatures and humidities not only for the storage and processing of the materials but for comfort of the customers and personnel as well. He describes the recently completed year 'round installation for the new Zintsmaster studio, a 25 ton job with reheat, five independently controlled zones, "skin" heating with convector radiation for the exposed walls and glass surface. Condenser water is wasted to the roof to absorb solar heat

IMPORTANCE OF air conditioning for process control in the printing industry has been realized for some time, especially in multi-color offset work, where proper temperature and relative humidities must be maintained in equilibrium with the moisture content of the paper to prevent dimensional changes in the paper.

The photographic industry, similar in some respects to the printing industry, also realizes the importance of air conditioning for control of processes. The conditions for the storage of sensitized paper and film are of great importance, as are the conditions for developing, printing, and finishing.

In commercial photography, human comfort in the studios and dressing rooms is also a prime requirement. This is the "business end" of the industry, and the customers who come to have photographic portraits made must be interviewed, arranged, and posed (under floodlights) in a comfortable atmosphere.

Recent Installation a Good Example

As an example of photographic studio heating and air conditioning, let us consider the recently completed installation for the new Zintsmaster studio, Minneapolis. This is a basement and single story structure with provisions for a future second story. It is of steel, brick, and stone construction, and is windowless except for the front and rear of the main floor.

Commercial photographic studios need air conditioning not only for process reasons, but for comfort of the customers and personnel

The building is furnished with modern and complete photographic camera and process equipment to produce excellent portrait and commercial photography.

The basement is occupied by the developing and printing department. A vault for storage of sensitized paper and film is also in the basement, as well as the boiler room and air conditioning equipment room spaces.

On the first floor of the building are the photographic studios, dressing rooms, and the photo finishing, framing, and office spaces.

The entire building is served by a central air conditioning plant designed for year 'round operation as required for the control of the processes and storage, as well as for comfort.

An automatic oil fired steam boiler is installed and operated the year 'round, as a part of the split system of heating and air conditioning—with "skin," or exposed building surface, heating being accomplished by convector radiation, and supplemented by five zones of indirect heat boosters in the air conditioning system.

Temperatures and Humidities Required

The following are optimum conditions conducive to good practice for photographic laboratory processes in studios:

	Temperature F	Relative Humidity Percent
Developing of film	70-75	60
Film drying	75-80	50
Printing	70	70
Cutting	72	65
Finishing and framing	72	50
Storage vault	60	45
Studio, dressing rooms, and offices	74	30-40

To meet these conditions, it is necessary to provide means for zone humidification, as well as zone reheat.

In the printing and developing room, it is desirable to maintain proper temperatures for developing solutions and rinse water, in addition to maintaining proper ambient air temperature and humidity. In this department, considerable heat is liberated from the printing, enlarging, and drying processes, and

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this heat must be removed through an independent exhaust system connecting the lamp houses and dryer hoods.

The total winter heating load for the studio building is 360,000 Btu per hr maximum, based on maintaining the proper inside conditions when the outdoor temperature is minus 20 F.

The total summer cooling load for the building is 272,000 Btu per hr, of which 85 percent is sensible heat and 15 percent latent. This cooling load is based on maintaining an inside temperature of 78 F and 50 percent relative humidity, with outdoor conditions of 98 F dry bulb temperature and 78 F wet bulb, and it includes heat pickup due to solar radiation on exposed surfaces of the glass, walls, and roof of the building.

The cooling load calculations are further based on the following:

Total air conditioned space cubage	57,970
Total number of occupants	35
Total light and electrical equipment wattage	16,500
Outdoor air introduced for ventilation	20%

Duct System Provides Independent Zones

Air distribution throughout the building (with the exception of the printing and developing rooms) is by means of supply and extract ceiling type diffusers, installed in connection with a complete duct system for supply, return, exhaust, and the outdoor air introduction.

This duct system was fabricated of sheet aluminum, and is installed concealed above the dropped and furred ceilings. The duct system was designed and installed for five independently controlled zones of operation required to meet the conditions for year 'round control of process and comfort requirements.

The air conditioning system has a total air handling capacity of 8400 cfm, a total heating capacity of 285,000 Btu per hr, and a total cooling capacity of 25 tons refrigeration.

Air distribution is by means of supply and extract type ceiling diffusers, except in the printing and developing rooms

All of the air handled by this system is cleaned by a bank of renewable type filters, with provisions made in the plenum chamber for the future installation of a primary electrostatic type air cleaner.

During winter operation, the mixture of outdoor air and air recirculated from the space is preheated by a bank of nonfreeze type steam coils, after which humidity is added by a vaporizing pan type humidifier, before passing through the five zone reheat booster coils and humidifiers.

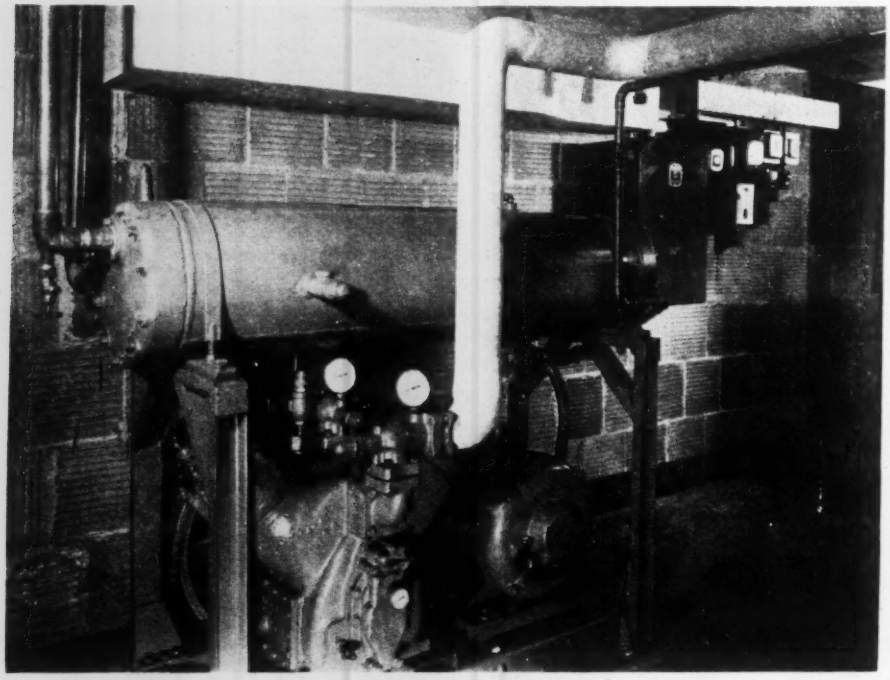
During summer operation, all of the air mixture is cooled and dehumidified through a six row deep "Freon" evaporator bank of coils located in the main air conditioner housing, with reheat and humidification added as required and called for by demand of the five master zone controls located within the spaces served.

The convector radiation for skin heating of the exposed walls and glass surfaces is also zoned, and is controlled independently from the air conditioning system.

The refrigeration system includes a 25 ton "Freon-12" reciprocating machine fully automatic in operation, provided with automatic capacity reduction, and control for maintaining a constant refrigerant evaporating temperature required when operating at a reduced and varying load demand.

The automatic air conditioning and heating control system is of the pneumatic type, with all steam con-

The 25 ton reciprocating refrigeration machine is fully automatic in operation. Condenser water is wasted to the roof to absorb solar heat



trol valves and dampers being of the modulating type and actuated by pneumatically operated motors.

The entire duct system, main air conditioner housings and plenums are insulated with a 1 in. thickness fireproof insulation to prevent excessive losses of heating or cooling effect.

Diffusers in the printing and developing rooms are of the supply type only, as all air supplied to this department is exhausted through an independent system installed to remove the heat liberated from the lamp houses of the printing and enlarging machinery. This excess is exhausted to the atmosphere.

Condenser Water Wasted to Roof

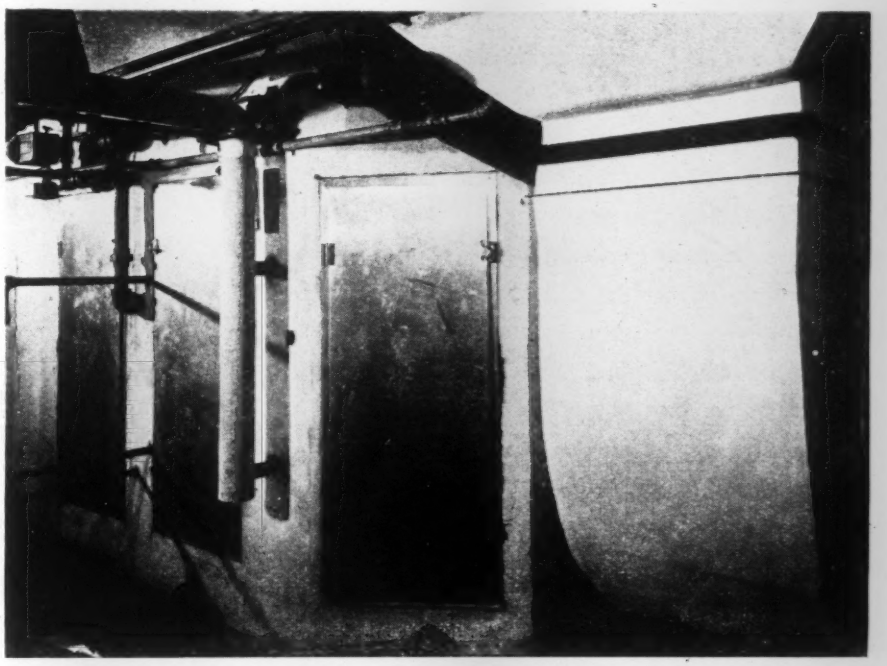
City water is used for condensing purposes in the refrigeration system, and is wasted from the condenser to the roof surfaces over the building to reduce solar heat effect by maintaining a wetted roof surface. This is a measure of operating economy, by double use of the water before wasting it to the sewer.

Separate and independent systems are installed for atmospheric exhaust to serve the process rooms and the toilet rooms. An equal volume of outdoor air is introduced to the building through the main air conditioning system as required to offset this volume of exhaust air, thus maintaining an internal static pressure balance within the building to prevent infiltration of unconditioned air when doors are opened.

The architects for the building were McEnary & Krafft, Minneapolis, and the Spencer Air Conditioning Co., Minneapolis, designed and installed the heating and air conditioning systems.

COLOR, LIGHT COMBAT SUBMARINE'S MONOTONY

The atmosphere of the submarine has always required study and control, not only as regards oxygen content, but also for noxious gases and fumes, including hydrogen from the storage batteries, chlorine generated by salt water gaining access to the sulfuric acid of the storage batteries, and carbon dioxide content of the atmosphere inherent to long submergence, according to Captain Thomas L. Willmon, of the Medical Corps of the U. S. Navy, at the spring meeting of the American Society of Mechanical Engineers. Coincident with long submergence or even surface operation, in tropical waters, temperature and humidity control within the submarine were found to be mandatory, he said. Prior to air conditioning, 10 day patrols reached the absolute limit of human endurance, but during the war, 60 day patrols were not unusual, he pointed out. The air conditioning not only enabled personnel to tolerate these extended cruises, but also protected delicate electrical and electronic gear.



The aluminum duct system, housing, and plenums have 1 in. of fireproof insulation to prevent excessive loss of heating or cooling effect

"Duration of submerged running was limited by the battery capacity in our wartime submarine," Captain Willmon said. "In order to prolong submerged operation, the snorkelling device was developed. The snorkel is a rigid, streamlined, retractable housing containing two air conduits sufficiently large respectively to supply intake air and serve as engine exhaust, thus enabling the submarine to operate on engines while submerged.

"The top of the snorkel is fitted with a water-closing valve which is actuated when the snorkel head becomes awash through loss of depth control or advance of seas. Since the engines continue to function and draw air from the boat, this closure causes a reduced pressure to be induced within the submarine to the point that a switch automatically is activated to stop the engines. In a seaway there may be a continuous and rapid fluctuation of ambient pressure induced by frequent closures of the head valve.

"With the new snorkel submarine, the craft may remain submerged for days on end, having only the snorkel tube protruding to the surface. There is no difference between night and day. Operations become vastly more routine and monotonous to the point that boredom may intervene to the detriment of morale. One of the efforts to combat this factor we call 'Operation Rainbow,' consisting of color and light conditioning of the submarine's interior to effect a change of pace on walking from one compartment to another, creating illusions of greater space and depth to the interior and incorporation of adequate yet pleasant, nonglare lighting.

"The submarine heretofore has been coldly operational and utilitarian. Experimental results to date are most encouraging as regards reaction of personnel. We are not going so far as to create the impression of a boudoir," said Captain Willmon, "nor is it planned to atomize Tabu or My Sin through the compartments, but the attempt is to attain the ultimate of habitability within the limitations imposed by operation requirements."

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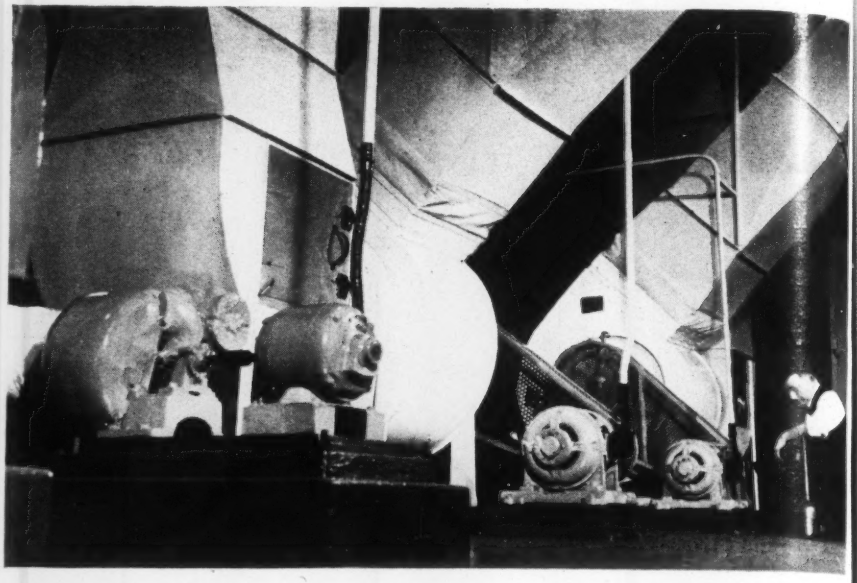
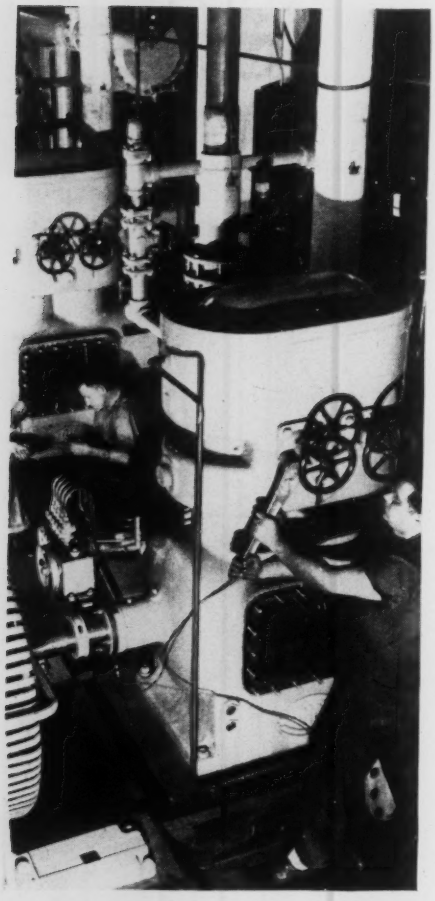
J. J. NOVOTNY, chief of facilities engineering at the Glenn L. Martin Co., Baltimore, points out that a planned preventive maintenance program for heating, ventilating, and air conditioning systems is essential—for "a chain is only strong as its weakest link." He briefly reviews the procedure, indicating some of the forms which bring economies through simplified operations



Planned Maintenance a "Must" at the Glenn L. Martin Plant



The maintenance crew adjusts one of the refrigeration compressors

To paraphrase the adage about the chain and its links, a system such as that which provides heating, ventilation, and air conditioning for the Glenn L. Martin plant, Baltimore, is no "stronger" than its "weakest" unit. Thus, in maintenance effort, much labor and material may be wasted if every part of such a system is not considered in each major overhaul.

Why Planned Maintenance?

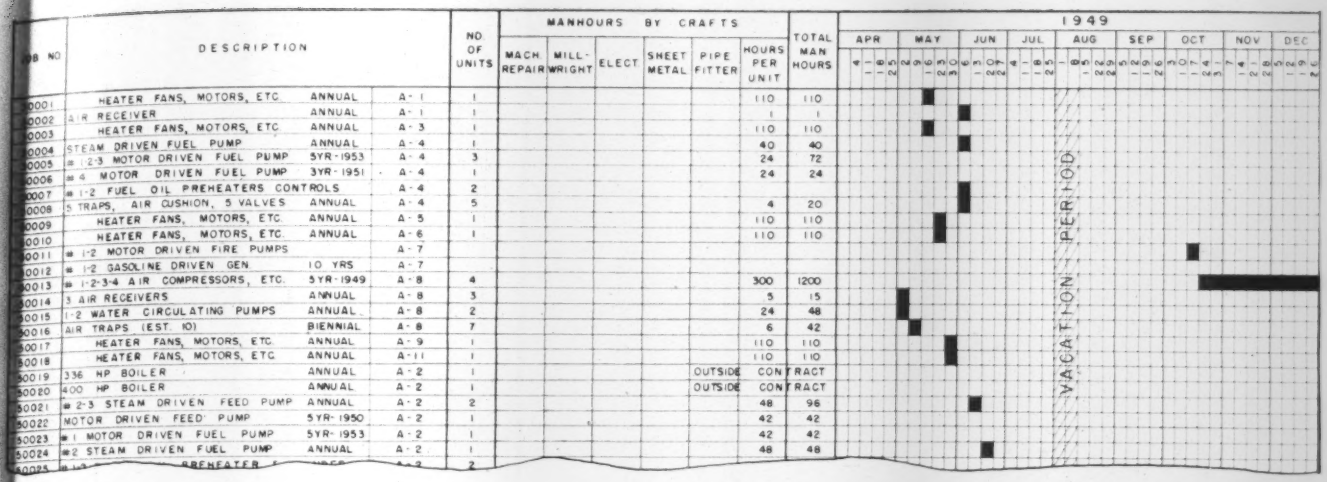
Illustrating this, suppose that trouble with a refrigeration compressor during one operating season indicated a necessary overhaul, but that the rest of the system gave no indication of trouble. The following season, the evaporative condenser was unable to balance the improved action of the compressor, because the coil was restricted with scale; the pump did not handle adequate water; and the fan capacity was not up to design—resulting in low-tonnage performance and high head pressures.

So the next season both the compressor and the evaporative condenser were properly overhauled but the ventilating system was forgotten. Neglect in keeping the ventilating system clean and the air handling capacity up reduced performance by as much as 20 to 30 percent.

Another example of maintenance coordination is the case of a compressor opened for overhaul. Some of the worn parts needing replacement are unavailable. Reworking of suction or discharge valve discs and springs will result in valve breakage before the next scheduled overhaul. It is practical to anticipate the need for such items as valves, wrist pins, and bearings. Again, neglect in dehydrating a system left open for any period of time may result in poor expansion valve operation, slugs of liquid, broken compressor valves, and erratic performance.

In short, a planned preventive maintenance program at the Glenn L. Martin Co. has become a must for three basic reasons: (1) operation costs require economical use of

JOB NO	DESCRIPTION			NO. OF UNITS	MANHOURS BY CRAFTS: MACH. REPAIR	MILL-WRIGHT	ELECT.	SHEET METAL	PIPE FITTER	HOURS PER UNIT	TOTAL MAN HOURS
50001	HEATER FANS, MOTORS, ETC.	ANNUAL	A-1	1						110	110
50002	AIR RECEIVER	ANNUAL	A-1	1						1	1
50003	HEATER FANS, MOTORS, ETC.	ANNUAL	A-3	1						110	110
50004	STEAM DRIVEN FUEL PUMP	ANNUAL	A-4	1						40	40
50005	#1-2-3 MOTOR DRIVEN FUEL PUMP	5YR-1953	A-4	3						24	72
50006	#4 MOTOR DRIVEN FUEL PUMP	3YR-1951	A-4	1						24	24
50007	#1-2 FUEL OIL PREHEATERS CONTROLS		A-4	2							
50008	5 TRAPS, AIR CUSHION, 5 VALVES	ANNUAL	A-4	5						4	20
50009	HEATER FANS, MOTORS, ETC.	ANNUAL	A-5	1						110	110
50010	HEATER FANS, MOTORS, ETC.	ANNUAL	A-6	1						110	110
50011	#1-2 MOTOR DRIVEN FIRE PUMPS		A-7								
50012	#1-2 GASOLINE DRIVEN GEN.	10 YRS	A-7								
50013	#1-2-3-4 AIR COMPRESSORS, ETC.	5YR-1949	A-8	4						300	1200
50014	3 AIR RECEIVERS	ANNUAL	A-8	3						5	15
50015	1-2 WATER CIRCULATING PUMPS	ANNUAL	A-8	2						24	48
50016	AIR TRAPS (EST. 10)	BIENNIAL	A-8	7						6	42
50017	HEATER FANS, MOTORS, ETC.	ANNUAL	A-9	1						110	110
50018	HEATER FANS, MOTORS, ETC.	ANNUAL	A-11	1						110	110
50019	336 HP BOILER	ANNUAL	A-2	1					OUTSIDE	CONTRACT	
50020	400 HP BOILER	ANNUAL	A-2	1					OUTSIDE	CONTRACT	
50021	#2-3 STEAM DRIVEN FEED PUMP	ANNUAL	A-2	2						48	96
50022	MOTOR DRIVEN FEED PUMP	5YR-1950	A-2	1						42	42
50023	#1 MOTOR DRIVEN FUEL PUMP	5YR-1953	A-2	1						42	42
50024	#2 STEAM DRIVEN FUEL PUMP	ANNUAL	A-2	1						48	48
50025	#1-2 PREHEATER		A-2	2							



manpower and equipment, and continuous effective use of controls; (2) maintenance requires adequate planned outage time to make correct repairs at minimum cost; (3) breakdown outages necessitating frequent emergency repairs would be costly, and disturbing to plant personnel.

The maintenance program considers and groups equipment into three general classifications, namely—summer, winter, and year 'round use. Proper planning, correct scheduling, and followup are producing reliable functioning of equipment and controls.

From November 1 to March 15, there are approximately 25 air conditioning systems, varying in size from 3 to 300 tons capacity, which are serviced and overhauled as called for in a master work schedule. These systems are of the direct expansion type, using "Freon-12" as refrigerant.

The plant engineering department uses this work schedule for heating, ventilating, and air conditioning

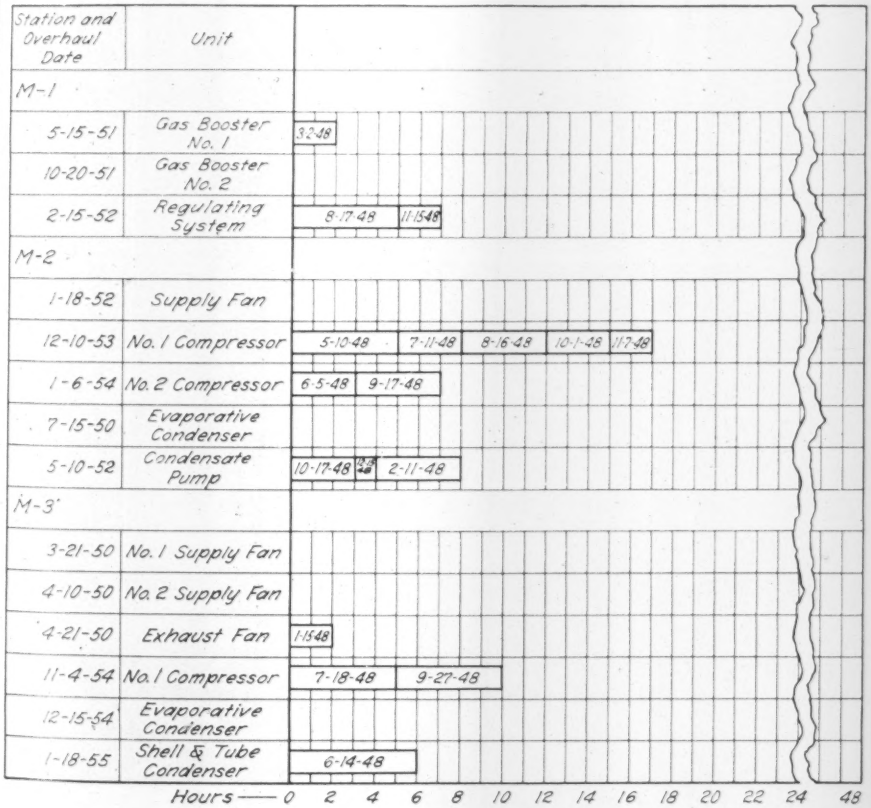
Keeping Air Handling Capacity Up

Maintenance of air capacity can be affected adversely as follows: (1) by improper action or sequencing of motorized dampers controlled by ductstats; and (2) by packing of the self-cleaning oil filter, gradual accumulation of dirt on preheat coils, cooling coils, reheat coils, or any zone booster cooling and reheat coils.

Test holes to read relative static pressures between a clean system and a dirty system have indicated that cleaning is required approximately every five years. Cleaning of supply and exhaust grilles should be accomplished as regularly as necessary to maintain a neat appearance in the areas served. Work on this part of the system is scheduled for the spring of the year, and accomplished on the second and third shifts—so as not to interrupt use of the ventilating system.

Another major item is represented by the supply and exhaust fans. These units should be checked for bearing and sheave wear—either of which reduces fan capacity. Mechanical overhauls to compressors, pumps, motors, exciters, controls, unloaders, evaporative condensers, and shell and tube condensers—which are housed inside—are scheduled during cold, inclement weather, while outdoor equipment is scheduled in the early spring of the year. Use of chemical compounds in the water, during the operating season, has eliminated expensive descaling of evaporative condenser and shell and tube condenser coils.

This is a sample of a service request and repair chart as used at Martin



Overhauling Office Heating Systems

From June 1 to September 1, all office heating systems are scheduled for overhaul and necessary service. Units such as traps, strainers, and bypass valves are overhauled every two years—as these are important in holding steam

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consumption at a minimum. It has been found that heating control systems can be serviced too frequently—becoming temperamental in their coordination with other controls of the system.

To offset this, and to obtain unified purpose and control, an overhaul of the entire system is scheduled approximately every five years. To guide both the operations and maintenance units in this work, a schedule of station control requirements with schematic drawings and wiring details is posted at each machine room. This arrangement has overcome confusion, stopped individual interpretation of control uses and setting, and contributed much toward eliminating employee dissension.

Servicing the Plant Units

From May 15 to October 15, general plant heating systems are serviced and overhauled—including fuel oil systems. The major portion of the plant is heated by 35 large direct fired heaters, varying in size from 1,500,000 to 5,500,000 Btu output. These units are cleaned and serviced annually, some of the burners being completely overhauled. All condensate pumps, fuel oil pumps, and auxiliaries scheduled for overhaul receive attention during this period.

Boilers and pressure vessels (such as air receivers and hot water coil heaters) are serviced and prepared for annual insurance inspection—since necessary outages can be arranged with manufacturing requirements. High tension substation switchgear and circuit breakers are inspected and serviced annually, usually during the plant vacation period. Other equipment on year 'round use—such as air compressors, steam distribution lines, and reducing stations—are scheduled for overhaul at varying intervals as dictated by experience.

These Forms Are Used

To control the operation, overhaul, servicing, and use of these systems and equipment the following forms are used:

The overhaul sheet is another of the forms which aid the preventive maintenance program

I. Master Work Schedule

II. Standard Procedure
   a. Operating Instructions
   b. Control Functions
   c. Station Requirements and Settings
   d. Operating Schedule

III. System Schematic and Detail Diagrams

IV. Overhaul Request Sheet

V. Renewal Parts Listing

VI. Service Request and Repair Chart

The uses of the forms noted under Items I, II, and III have already been indicated. The overhaul request, Item IV, is a check sheet which can be used for a repair or complete overhaul as marked. It indicates the detail work to be done. The form named as Item V lists the parts necessary to accomplish an overhaul or repair, and insures that necessary parts are available at the time the work is scheduled. Item VI connotes a most important sheet which develops and flags frequent service and repair to units or systems. Analysis of this chart affords a positive check, resulting in real control of overhaul frequencies and the spotting of poor repairs.

OVERHAUL SHEET

STARTING DATE | PED No.

DUE DATE | COMPLETION DATE | LOCATION PERSONNEL BUILDING P-1 | MANHOURS | MATERIAL COST | CHARGE No.

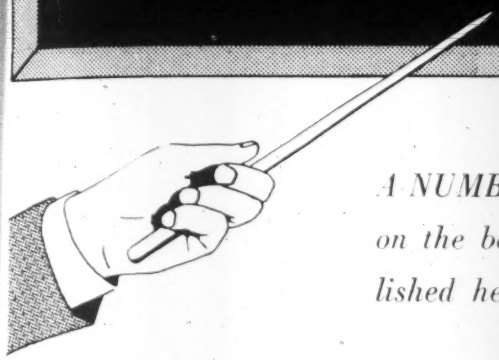
MAINTENANCE INSTRUCTIONS

A. OVERHAUL ONLY THOSE ITEMS THAT ARE SO INDICATED IN "TO BE WORKED" BOX ✓
B. WHEN OVERHAUL OF ITEM HAS BEEN COMPLETED, CROSS THROUGH CHECK IN BOX ✓
C. ENTER IN "REPLACEMENT BOX" THE NUMBER OF PART UNITS REPLACED
D. ENTER IN "REWORK BOX" THE NUMBER OF PART UNITS REWORKED

INSPECT – CLEAN – MAKE NECESSARY REPAIRS, REPLACEMENTS AND ADJUSTMENTS	UNITS TO BE WORKED	UNITS REQUIRED	UNITS REPLACED	UNITS REWORKED	MANUFACTURER	IDENTIFICATION
FREON COMPRESSOR						SIZE 8½ x 6 TYPE FC NO 1 SERIAL 40599 NO 2 SERIAL 43353
COLUMN	✓	1				PART NO. 100
CYLINDER HEAD	✓	1				PART NO. 101
STUD FOR CYLINDER HEAD	✓	20				PART NO. 102
GASKET FOR CYLINDER HEAD	✓	1				PART NO. 103
NUT FOR STUD FOR CYLINDER HEAD	✓	20				PART NO. 104
SAFETY HEAD SPRING	✓	2				PART NO. 105
CASE FOR DISCHARGE VALVE	✓	2				PART NO. 106
SEAT FOR DISCHARGE VALVE WITH STUD	✓	2				PART NO. 107
LARGEST RING PLATE FOR DISCHARGE VALVE	✓	2				PART NO. 108
NEXT TO LARGEST RING PLATE FOR DISCHARGE VALVE	✓	2				PART NO. 109
NEXT TO SMALLEST RING PLATE FOR DISCHARGE VALVE	✓	2				PART NO. 110
SMALLEST RING PLATE FOR DISCHARGE VALVE	✓	2				PART NO. 111
NUT FOR STUD-DISCHARGE VALVE	✓	2				PART NO. 112
LOCK WASHER	✓	2				PART NO. 113
SPRING FOR DISCHARGE VALVE	✓	48				PART NO. 114
BOLT FOR DISCHARGE VALVE	✓	2				PART NO. 115
LOCK WASHER	✓	2				PART NO. 116
DISCHARGE VALVE ASSEMBLY – SINGLE TYPE	✓	2				PART NO. 117
CASE FOR SUCTION VALVE	✓	2				PART NO. 135
SEAT FOR SUCTION VALVE	✓	2				PART NO. 136

BASIC PRINCIPLES OF PIPING

(A Review of Fundamentals)



A NUMBER OF comments from readers of Herman Vetter's articles on the basic principles of piping have been received and are published here, together with Mr. Vetter's replies to these comments

I HAVE READ with interest the article by Herman Vetter on basic principles of piping, in the March issue. I am afraid that in the attempt to discuss both refrigeration and steam piping, he has made some observations which would not work out in practical application. I have always found that high pressure steam piping must either pitch in the direction of steam flow or be horizontal and have condensate pockets at close intervals. In nearly any operation where the piping is pitched so that the condensation will flow in opposite direction to the steam it will be subject to breakage whenever the steam is turned on.

His Fig. 8 arrangement of a connection between a header and a boiler would be satisfactory if there were a continuous flow of steam from the boiler into the header and no shutoff valve was placed in the line, but if that particular boiler happened to be cut off the line, it would be very difficult to keep condensation from creating a hammer effect when the valve was opened even if a drain were placed above the valve. A bypass would not solve the problem.

Without Mr. Vetter giving more information about quantity of steam flow and other conditions, I cannot see how he could make the statement that the 5 in. connection in Fig. 7 of his article formed a bottle-neck. In all probability, this 5 in. connection would pass more steam than the boiler would evaporate with perhaps no more than a 1 lb drop in pressure. Anyone who follows the principles set forth in this article is very likely heading for trouble.—WALKER L. WELLFORD, JR., president, J. E. Dilworth Co., Memphis.

WHAT IS GOOD PIPING PRACTICE?

IN THE MARCH issue of HPAC, the article on basic principles of piping, by Herman Vetter, contains several statements and recommendations which I do not believe are in accord with good piping layout or standard practice.

The piping between the evaporator and the engine, as shown in Fig. 1 of the article, should decidedly not slope back to the boiler. It should slope toward the engine and a suitable moisture separator and trap be placed just ahead of the throttle valve. When the engine is running, steam flows through the pipe at 6000 fpm or more. Water will not trickle back down the pipe against a gale blowing at 60 mph. Instead, it will be picked up and carried into the cylinder where it may do great damage—immediately, by knocking out the cylinder head; or gradually, by washing the lubrication from the cylinder walls.

The principle of draining in the direction of gas flow in horizontal lines is one that should be carried out with all gases entraining moisture capable of being deposited during transmission through a pipe system. Failure to follow this practice will result in water hammer or slugs of liquid being picked up by the fast moving gas and hurled against fittings by inertia, when the light gas "turns a corner" at an elbow and the heavier liquid keeps moving in a straight line until abruptly stopped by the metal wall of the fitting.

The only exception in general work would be a small, single pipe, vapor heating job. To save the cost of running a return pipe from the end of the main back to the boiler, a parsimonious contractor will slope the main against the steam flow. This usually results in snapping and banging in the pipes when steam is being raised, and flowing rapidly through the system, as it meets quantities of condensate trying to rush the other way. After a while, the system fills with vapor, the rate of flow drops to a few fpm, and all is quiet—except the owner's nerves.

The header arrangements shown in Figs. 4, 5, and 6 would not be

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considered the best practice by many designers, due to complication and lack of provision for continuity of service. A better layout would be a continuous loop connecting all boilers and all engines. Since this would usually be feeding both ways, the pipe size could be made smaller than if only a single pipe is used to connect one end of the boiler header to one end of the engine header. This reduction in size would partially compensate for the extra pipe used to form the loop. By using strategically placed isolating valves, sections of the header could be shut off for repairs to leaking joints, stop valves, packing, etc. In hotels, institutions, and industries operating continuously, this feature is a necessity to insure against shutdowns for minor repairs.

The examples given in Mr. Vetter's article for various design conditions are carefully worked out but they are based on a fallacy, and I do not believe that units connected with the pipe sizes given would operate in a satisfactory way under full load conditions. The false assumption is that an engine takes steam continuously and in the rate of flow.

Actually, an engine takes steam into the cylinder for only part of the stroke. The inlet valve shuts off the admission of steam at a point, usually between $\frac{1}{8}$ and $\frac{1}{2}$ stroke, and the steam operates expansively for the remainder of the stroke. Since the total quantity of steam is flowing in only a fraction of the total time, it follows that the velocity must be equal to the cfm divided by the fraction of the stroke before cutoff. Assuming cutoff at some fraction of the stroke will show that the pipe sizes given in the examples are far too small and would result in a considerable drop in pressure at the throttle valve.

Manufacturers of engines usually furnish throttle valves, or at least the flange connection on the cylinder, which their experience has shown to be the proper size for good operation. This is based on other considerations than theoretical flow at a theoretical pressure and theoretical consumption per hp-hr. In practice, a sharp temporary reduction in boiler pressure may take place during operation. This drop may be due to cleaning fires, a sudden increase in load, or other emergency. This is when amply sized lines pay off, as it is only possible to maintain engine speed with low steam pressure if every ounce is made available at the cylinder. As valves and cylinders wear, the steam consumption per hp increases. Due to the larger steam flow, there will be a greater drop in pressure between the boiler and engine. The engine governor will have to hold the admission valves open longer, using up still more steam. The end result will be a unit which cannot carry its rated load.

The boiler connection shown in Fig. 7 is correct for a single boiler installation. If another boiler is added to the pipe system, a combination stop and non-return valve must be placed between the header stop and the boiler. One of the reasons for the 5 in. connection being too small for the present load is the reduction in pressure. Steam at the design pressure of 160 lb has a volume of 2.6 cu ft per lb while at the operating pressure of 115 lb, the volume is 3.4 cu ft. An increase in volume of some 30 percent is required to pass through the same size line, resulting in increased velocity and greater pressure drop.

The boiler lead arrangement shown in Fig. 8 is open to the same objection as the piping shown in Fig. 1—water will not trickle down a slight slope against a tornado going the other way. A layout as shown in Fig. 7 is good because there are no pockets for condensate. It would be better if an easy bend had been used in place of the elbow to the header.

The next to the last paragraph of Mr. Vetter's recommends the use of a bypass around the stop valve in Fig. 8 to warm up the piping. This is good practice, but I do not understand how this bypass can also be used as a drain valve. The header should have drains open to atmosphere, before any steam is turned into it. Failure to take this precaution probably will result in surging and water hammer in the piping caused by condensation and water in low spots in the lines.

Placing stop valves on or close to boilers and evaporators, as described in the last paragraph, should always be done in good layout work. However, the reason given, "the pressure can be shut off, permitting repairs without shutting down the evaporator," does not make sense to me. When the stop valve is closed, the boiler is shut down. This is self-evident as no effect can be had from any evaporator when its outlet is closed.

I trust these comments will be helpful, particularly the ones on counterflow of steam and condensate, as great damage can be done by neglecting proper pitch in pipe lines.—J. L. ANDERSON, Seabrook, N. J.

HOW TO PITCH STEAM PIPING

MAY I COMMENT on one point in Herman Vetter's article on piping principles in the March HPAC? The author recommends that steam mains be pitched back from the engine toward the boiler in a direction opposite to the flow of steam.

For 20 years, I lived with the design, construction, and operation of a steam distribution system, including literally miles of mains in a half-mile square group of factory buildings. The system was started in the 1870's. Around 1910-15 we had everything—pitch toward the boilers, from the boilers, no pitch at all; low pressures; power plant pressures of the time, with and without superheat; low steam velocities; high steam velocities. I do not remember any considerable length of piping larger than 14 in.

From my experience I would take exception to Mr. Vetter's recommendation. With any ordinary pitch of main, water will not flow back against steam having any velocity ordinarily used in practical design, except unusual cases of very very long exhaust heating mains. This checks roughly with the results of some experiments which were published in 1922. From these tests made near atmospheric pressure and in part with glass piping, it was concluded:

1) The size of pipe has no visible relation to the critical velocity (practically the same for all sizes tested).

2) The critical velocity did not vary a great deal with pitch. At $\frac{1}{4}$ in. to 10 ft it was approximately 700 fpm, increasing to approximately 1300 at a grade of $1\frac{3}{4}$ in. to 10 ft, and did not reach 1400 fpm even at 4 in. to 10 ft.

With steam at higher pressures, the critical steam velocity at which water ceases to drain back against

steam flow is lower, for the gas is denser and friction at the interface is greater. Once waves are set up on the water surface, the impact effect of the gas flow on the waves is of course greater also.

In opening up a valve into a cold line, whether throttling the main valve or opening a bypass, the velocity through the valve will be too great to allow water to drain back. At velocities which will frequently occur in any steam main of ordinary design, water will be carried along with the steam, whether it be pitched with or against steam flow.

During a period of low velocity (lunchtime, shift changing time), in a main pitched in the direction of steam flow, water is travelling toward the branches. In the case of an overhead main, intelligently planned, with branches to applications which work well with wet steam taken from the bottom of main, and branches to other applications taken from the top, most of the water will collect where it will be disposed of without incident in starting up again. Any water which is flowing in the bottom of the main will have flowed toward the end of the main and if picked up in steam flow at starting up time will have a far shorter distance of travel in which to gather speed, than is the case in a main pitched against steam flow.

To put the matter another way: Water which is piled up behind the throttle valves or shutoff valves of the utilization equipment when it is started never gets a chance to travel far. It never gathers speed enough to produce a severe water hammer.

Water which is flowing toward the boiler along the bottom of the pipe is getting farther and farther from the end of the main. When the steam velocity increases and water is picked up in slugs, water near the boiler travels farther and gains more velocity before the slug hits something.

Properly dripped and trapped, mains planned either way are operable. It is when some nitwit shuts off a drip line, or some other unusual hazard arises, that one realizes the difference.

Counterflow pitching of mains was usual in the '80s but was seldom seen in new work after the first world war.—ROBERT W. DRAKE, Middlebury, Vt.

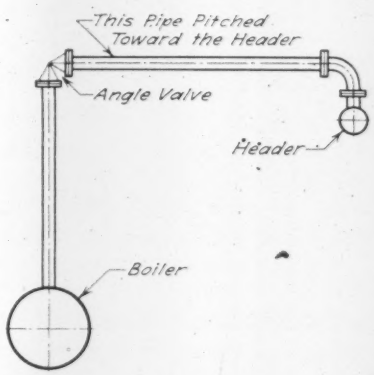
SUGGESTS DIFFERENT HEADER LAYOUT

REFERRING TO the article by Herman Vetter in the March HPAC, on basic principles of piping, I think that the arrangement of piping shown in Fig. 8 of the article is not ideal by any means. In my opinion, the layout portrayed on the accompanying sketch has much to commend it for the following reasons:

1) There is no possibility of condensate accumulating on top of the valve when the boiler is shut down.

2) Except in the vertical rise of pipe to the angle valve, the condensate will flow with the steam instead of against it.

3) The pressure drop across a globe valve is approximately twice



This header arrangement has a number of advantages, says Mr. Isherwood

that across an angle valve. This argument of course only applies if the main stop valve is of globe pattern.

The arrangement shown in Fig. 1 of the article will not in all cases be satisfactory, as there is a tendency for the condensate to be carried up the pipe, especially if the steam is travelling at any sort of velocity. A better layout would be to arrange for the piping to pitch toward the engine and to put a trap just before the engine stop valve.—A. D. G. ISHERWOOD, J. R. W. Murland, consulting engineer, Belfast, Ireland.

AUTHOR REPLIES TO PIPING ARTICLE COMMENTS

THE COMMENT questioning some of my statements on steam piping in my article in the March issue is a healthy sign. Too many people are afraid of sticking their necks out by questioning statements appearing in print. Questions are helpful to both readers and authors.

The essentials of the questions (and the sequence in which they will be answered) are as follows:

1) Do low pressure refrigerant vapor piping and steam piping have similar characteristics?

2) Counterflow drainage of steam lines?

3) Arrangement of distribution header above boiler as shown in Fig. 8 of my article?

4) Bottle-neck in 5 in. connection between boiler and 12 in. distribution header, as shown in Fig. 7?

Answer No. 1—In a steam system, the pressure in the lines may range from 5 psi to, say, as high as 800 psi, whereas in a refrigerating system, the pressure for ammonia may range from "below atmosphere" to 70 psi, and for CO_2 the pressure may be in excess of 1000 psi. The condition of the refrigerant vapor may be wet saturated, dry saturated, or superheated.

Refrigerant vapors and water vapor are similar in the pressure and vapor condition, varying only in the temperature and viscosity. The actions and reactions of either of these vapors are therefore similar and can be treated in similar manner.

When I began practicing in the refrigeration field, refrigeration engineering was considered as being so different from steam engineering that the knowledge available for steam design was not put to use until many years later. While taking a post-graduate course at Cornell University, Professor R. L. Shipman explained the similarity of steam and refrigeration engineering. To the best of my knowledge, Cornell was the first college to have a fully equipped refrigeration plant in their laboratory, and the first school to teach refrigeration engineering.

Answer No. 2—Before I answer this question, I would like to interpose one: Why won't condensate flow down hill to the boiler? The answer is naturally that it will, providing there is no force counteracting the force of gravity. The next question therefore is, what is this counterforce, and why is it there? The counterforce is steam at high velocity along the walls of the pipe.

In the earlier days of steam en-

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gineering, steam lines were successfully drained counterflow. The laws of nature haven't changed but these laws are not always utilized.

In my article in the December issue, the three general types of fluid flow were discussed; they are turbulent flow, transition flow, and laminar flow. It was also stated that there are times when a turbulent flow is desired, such as for heat transfer purposes, but it is not desired for conveying fluids economically.

Turbulent flow is due to high velocity; obstructions in the pipe line such as valves, bends, tees, etc.; and from rough pipe wall surface. In turbulent flow, the velocity of the fluid at the wall surface is so high that it produces a curling motion or wiping action; consequently, if the pipe line is pitched against the steam flow, this turbulent action will impede the drainage of the condensate and cause water hammer.

In transition flow, the fluid velocity at the wall surface is so low that no turbulence is produced; consequently, condensate will drain in the opposite direction to the steam flow but at a retarded rate and with no water hammer effect.

In laminar flow, there is no noticeable velocity at the wall surface and the condensate will flow freely in the opposite direction to the steam flow.

Believe it or not, I have seen a steam plant where the condensate flowed in the same direction as the steam in the risers. This plant was in New York City and the boiler was on the top floor of a four story building. The steam flowed down the risers instead of up, as is the case in most plants.

While on the subject of pipe line velocities, it may be well to discuss standards for sizing pipe lines. Due to competition, pipe sizes have often been whittled down. This practice led to standards for the maximum capacities for various size of pipe lines. Such standards are therefore minimum sizes and are not based on economy of operation. Many independent engineers do not use such standards in designing plants because excessive velocities are beneficial only to the sale of equipment and the sale of fuel.

Answer No. 3—The distribution header shown in Fig. 8 of my March article was for one boiler only. When more than one boiler is connected to a header, it is good practice to have two valves between the boiler and the header, one at the boiler nozzle and the other at the header connection. The purpose of the two valves is for protection when one boiler is to be opened for inspection while the other boiler is in operation.

Answer No. 4—Many people confuse the principle of an orifice with a constricted pipe line. The bottleneck illustrated in Fig. 7 is a section of pipe more than 10 ft long and is not an orifice plate.

This question can readily be answered by using a method suggested to me by a prominent engineer. He said that a simple way to ascertain the truth or fallacy of a statement was to exaggerate the factors. In our case, assume that the pipe line is reduced in size to ½ in. instead of 5 in. Would the same quantity flow through it? If this isn't convincing, reduce the size to ⅛ in.

The amount of flow through a pipe line does not fall off abruptly as the line size is continually being reduced in size and increase in pressure drop alone will not keep the volume constant through the full range of pipe sizes.

In reply to the statement that my recommendations are not in accord with good piping layout or standard practice, apparently our correspondent thinks that standard practice is necessarily good engineering practice.

Before entering private engineering practice, I held positions as chief engineer with several manufacturing companies. While thus engaged, I sized pipe lines in accord with standard practice, as I was working in the interest of the company and did everything possible to reduce construction cost. In engineering practice representing the owner, it becomes my responsibility to size pipe lines for economy of operation and minimum of maintenance. Economy of operation goes hand in hand with economy of maintenance.

An engineer who sizes his steam lines of ample size so that the lines can drain towards the boiler is called parsimonious. This is an error, it seems to me. The parsimonious engineer is one who sizes his lines so small that it requires a return line for draining the condensate back to the boiler.

If my remarks on the reason for placing the stop valve at the outlet of all pressure vessels had been read carefully, it would have been realized that my statement applied to all pressure vessels and not specifically to the layout mentioned in one of the above comments on my article.

In reply to Mr. Isherwood:

1) The arrangement of the globe valve on top of the boiler as shown in Fig. 8 of my article cannot trap condensate if the valve is open. If the valve is closed, condensate will collect even if the valve is of the angle type.

2) The question of draining condensate against the steam flow has been answered previously.

3) It is true that the pressure drop across an angle valve is less than across a globe valve. However, the type of valve recommended for this service is the stop-check valve; in fact, this type of valve is compulsory in places under boiler and insurance inspection. In this type of valve, if of the globe type, the pressure drop through the valve is less than for a standard type of globe valve.

In connection with the location of the stop valve on top of the boiler, there seems to be a misconception of the purpose of this valve. If the plant consists of only one boiler, this valve can remain opened during shutdown periods. Under normal operation, there is no need to close this valve except when repairs are to be made on the line or to equipment connected to the steam line.

If this valve is open during the warming up period, no condensate can collect as the lines will drain continually and as no steam is being used except for warming up the steam velocity is very low and cannot cause water hammer. Furthermore, as the lines warm up gradually with this valve open, the stresses due to temperature changes in the piping will adjust themselves gradually and prevent a sudden stress in the metal.

In practice, it is a good policy not to close a valve oftener than absolutely necessary so that the valve seat will be in good condition and hold tight when the steam pressure must be cut off during periods of repair.—HERMAN VETTER, consulting engineer, Los Angeles.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Readers Answer Request for Header Design Data

In a question published in the April issue, "R.L." said he would appreciate information and comment on the mixing of 125, 85, and 15 lb steam lines in a common return header to the boiler, and the method to be used to keep the back pressure down. Several readers have prepared answers to this question

IF I UNDERSTAND the question from "R.L." in the April HPAC on mixing of 125 lb, 85 lb, and 15 lb steam lines in a common return header to the boiler, and what method can be used to keep down the back pressure, it refers to discharge of condensed steam, i.e., condensate, from equipment operated at the different pressures listed into a common return. There may be some eductors or other devices that might tend to prevent pressure building up in the lower pressure lines, but the more obvious solution is to maintain the pressure in the header lower than the lowest discharge pressure by running the return header to a returns tank vented to atmosphere through a back pressure valve.

On page 900 of the Piping Handbook, 4th edition, a drip receiver with float controlled pump is illustrated, which would give this result.

Where two or more traps discharge into a common header, of course, check valves should be installed in the discharge of each trap before it joins the header. The header must be at a lower pressure than the line draining a particular piece of equipment. A reasonably large header operating at something below 15 psi and discharging into a receiver would conceivably meet the several pressure requirements of 15 to 125 psi. Since the boilers in the plant apparently operate at 125 psi, boiler feedwater pumps would be used in any event.

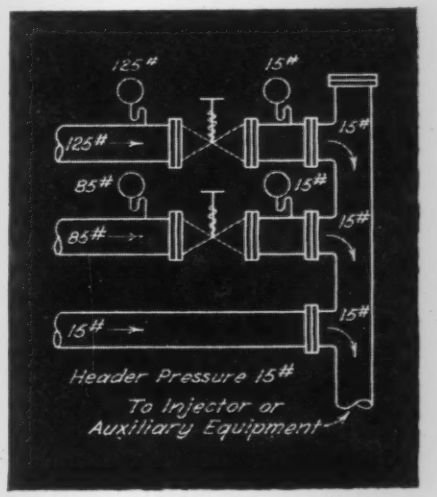
I believe that this reply is in line with common practice in collecting and returning heating and miscellaneous drips from power plant equipment.—A.M.

THIS METHOD PROVED SATISFACTORY, EFFICIENT

IN REPLY TO the request of "R.L.", published in the April HPAC, for information on mixing 125, 85, and 15 lb steam lines into a common return header to the boiler, and at the same time keep the back pressure down, I have found a system that will do the job both efficiently and economically.

The equipment necessary would consist of two steam pressure reducing valves. As shown in the diagram, a steam pressure reducing

Here's the system for mixing 125, 85, and 15 lb steam which "J.B.H." has found to be "satisfactory, economical, and efficient"



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valve would be installed in the 125 lb line to reduce the 125 lb to 15 lb steam pressure and a steam pressure reducing valve installed in the 85 lb line would reduce the 85 lb to 15 lb steam pressure. This design would, of course, have all three steam lines discharging into the common return header at the same steam pressure and would eliminate the possibility of back pressure in the 15 lb and 85 lb lines.

In the event that a pressure lower than 15 lb was required in the common return header, a third pressure reducing valve would necessarily be placed in the 15 lb line. The three pressure reducing valves would then be set to discharge the required steam pressure. If this steam is to be used for return to the boiler, it would be fed to an injector. Should the steam be needed for some auxiliary equipment, the pressure reducing valves could yield any pressure desired up to 15 lb.

The writer has had extensive experience with this type of problem in the marine field, and the method described above has proved satisfactory, economical, and efficient.—J.B.H.

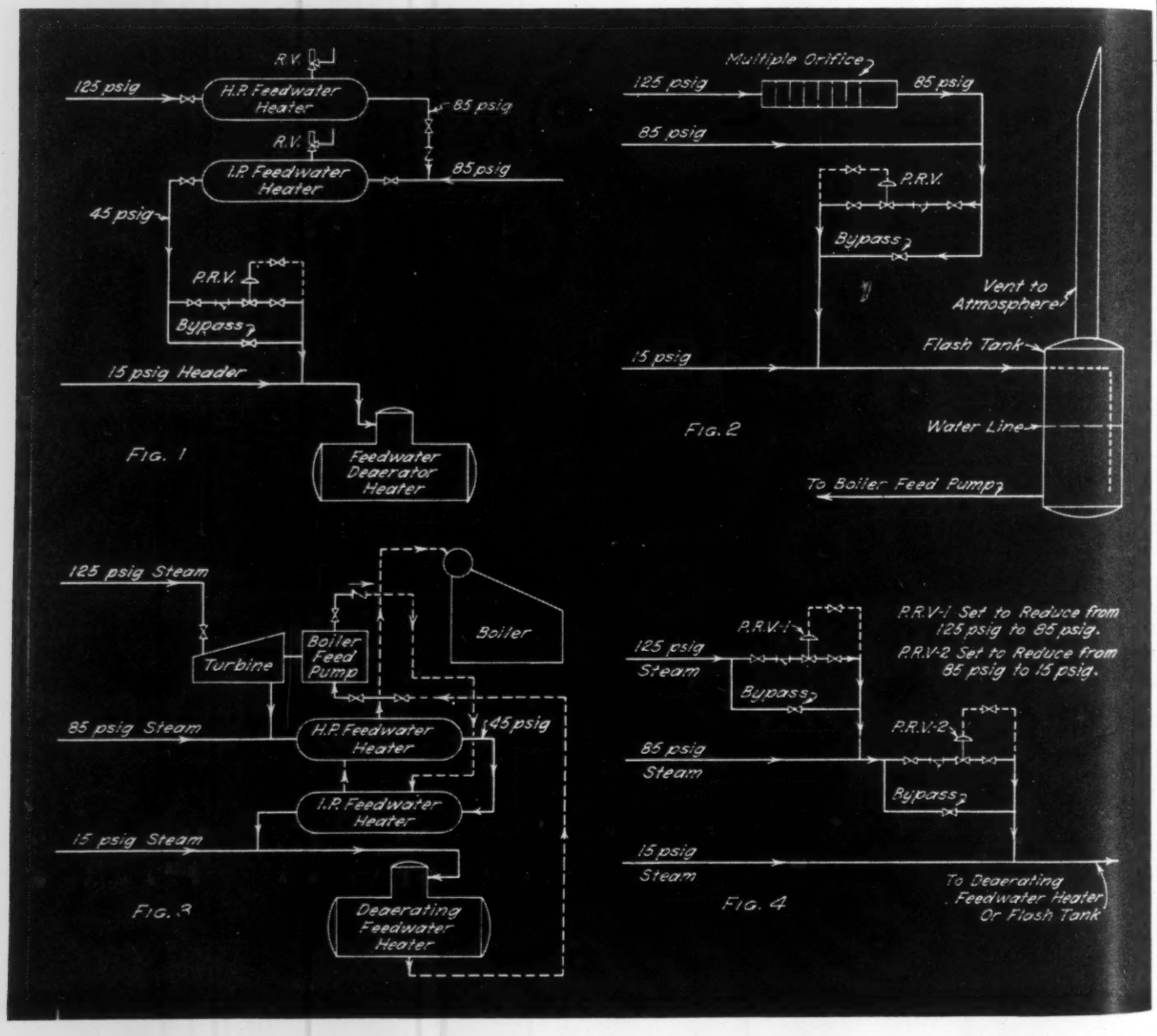
UTILIZE THE ENERGY IN THE STEAM

REPLYING TO "R.L.'s" inquiry in the April HPAC on mixing of different pressure steam in a common header, it would be impractical to mix them without first reducing the higher pressure steam to that of the lowest pressure.

He states that he wishes to mix steam at 125 psig, 85 psig, and 15 psig. Since the two top pressures represent superheated steam it would be wasteful merely to reduce the pressure without making use [illegible] the available heat energy. He should make a check on the heat balance of his plant to see whether it would be practical to put this energy to work and thereby increase the overall efficiency of the plant.

There are several ways in which the heat energy may be used: (1) feedwater heating, (2) driving pumps by turbine, (3) steam [illegible]

Fig. 1—The 125 psig steam flows to a high pressure water heater in the scheme suggested by "S.R.H." . . . Fig. 2—In this suggestion from "S.R.H.", the 125 psig steam is reduced to 85 psig by a multiple orifice . . . Fig. 3—Here, "S.R.H." shows the 125 psig steam entering the noncondensing turbine on a boiler feed pump . . . Fig. 4—This sketch by "S.R.H." shows the 15 psig steam going to a deaerating heater



sump pumping, (4) heating plant domestic water, (5) soot blowers, (6) turbine driven forced draft or induced draft fans, etc.

In Fig. 1 the 125 psig steam flows to a high pressure feedwater heater which could be designed to drop the pressure to 85 psig. Then the 85 psig steam could be used to heat the intermediate pressure feedwater heater, dropping the pressure to 45 psig. This steam could then be reduced to 15 psig by a pressure reducing valve. The 15 psig steam could then be used to operate the deaerating feedwater heater where most of it is condensed. From here it is picked up by the boiler feed pump and pumped through the water side of the intermediate and high pressure feedwater heaters and then back to the boiler, as in Fig. 3.

If the plant does not warrant a deaerating heater, then the steam could be run to a flash tank type of condensate receiver, as shown in Fig. 2.

In Fig. 2, the 125 psig steam could be reduced to 85 psig by a properly designed multiple orifice. Then, by a pressure reducing valve set up, the 85 psig steam could be reduced to 15 psig. It could be returned to the flash tank or condensate receiver where it would be picked up by the boiler feed pump.

In Fig. 3, the 125 psig steam would enter the non-condensing turbine on the boiler feed pump. It would exhaust at 85 psig. The 85 psig steam could be put through a high pressure feedwater heater and an intermediate pressure feedwater heater and then to the 15 psig header and returned as shown in the sketch. There should be a check valve on the discharge side of the pump.

Fig. 4 is another method that could be used although it not as economical as the others. In this method, after the steam is reduced to 15 psig, it should go to a deaerating heater rather than a flash tank as it contains a lot of the original heat which should be put to use.

In each case it would be necessary to keep the pressure slightly above the next lower step—enough to compensate for friction losses in the piping.—S.R.H.

Answers Are Invited For These Two Air Conditioning Service Questions

You are invited to answer the following questions from a reader of HPAC. Suitable comment on the matter will be welcomed, and—space permitting—will be published. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

"I was very interested in the information on servicing air conditioning installations published in the Question of the Month department in the May HPAC. In this connection, I'd like to submit the following two questions:

"1) What steps, if any, can be taken to prolong the life of a water valve seat? We find it hard to make them last one season. Our city water leaves them pitted in this short length of time.

"2) Has anyone in this line of work developed a good sales promotion scheme with his service men to secure additional air conditioning service contracts and service work?

"Comment and information on these two matters would be of considerable interest to me—and, I am sure, to other readers."

—J.M.C.

DESIGNING VENTILATION FOR MATERIALS HANDLING

Fundamental considerations in the design of exhaust ventilation for solid materials handling operations were discussed in a paper by R. T. Pring, J. F. Knudsen, and Richard Dennis, of the industrial hygiene department of the Kennecott Copper Corp., Garfield, Utah, in a paper prepared for the meeting of the division of industrial and engineering chemistry of the American Chemical Society in San Francisco. The complete paper is scheduled for publication in the November issue of the American Chemical Society's Industrial and Engineering Chemistry.

Solid materials handling includes dumping, storing, discharging, feeding, conveying, elevating, screening, mixing, loading, and filling of solids, in which operations no change of state of the material occurs. Dust is the atmospheric contaminant and is dispersed into the workroom by air currents set up by the movement of the solid particles.

Exhaust capacities required to eliminate dust dispersion at material transfer points have heretofore been determined by experimental methods or by use of arbitrary standards having little relationship to the actual forces creating the air movement. It was believed that the rate of air flow induced by falling material follows certain definite laws which have, in plant-scale experimental work, been obscured by external conditions and lack of precision in obtaining data. Accordingly a series of laboratory experiments were conducted under carefully controlled conditions in which the volume of air entrained by droplets of water falling into a simple open top tank was determined.

It was found that the rate of air entrainment was a function of the velocity of fall, the square root of the relative surface area of the droplets, the square root of the cross-sectional area of the column of falling particles, and a variable *N*, which has been defined as the relative number of particles in a unit system of single, successive droplets falling in line. The rate of air entrainment was also an exponential function of the ratio of length to width of the column cross-section.

Practical application of these data requires redefinition of certain variables in terms of solid particles and the evaluation of factors covering particle shape and surface characteristics and crowding of particles, all under field conditions.

Hooding and enclosing of material transfer points must be effected in such a way that no coarse material enters the exhaust ducts. Typical applications are illustrated in the paper.

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High Pressure Hot Water Heating

I HAVE READ with interest and profit the recent articles and discussions in HPAC on high pressure hot water heating. Having had more than 20 years experience in the construction and in the operation and maintenance of the central hot water heating system of the city of Dresden, I submit the following comments and observations in the hope that they may be of interest and of value to some of HPAC's readers.

The construction of the municipal system of Dresden was begun in 1927; at the time of its completion, it was probably the largest heating system of its kind in Europe. The system was in continuous operation until 1945, when it was partially destroyed by war activities; since then, it has been in use only to a limited extent, and my description applies to its prewar status.

295 F Flow Temperature

The system is combined with a power station whose boilers deliver steam at a pressure of 544 psi and a temperature of 770 F. The turbines of the power system are provided with extraction valves. The hot water is not taken directly from the boilers but is taken from heat exchangers which are heated by exhaust steam in two stages; at the first stage (about 85 percent) with steam of 30 psi and 420 F; at the second stage (about 15 percent) with steam of 150 to 220 psi and 500 F. By heating the water in two stages, it is possible to produce as much electric current as possible with the steam before it is used for heating.

The temperature of the water in the flow line of the heating system is 270 F in the summer and 295 F in the winter, but the temperature can be raised at any time to a maximum of 360 F. The temperature of the water in the return line varies from 180 to 195 F, and the total temperature drop from 90 to 120 F. The static pressure in the system of 80 psi is produced by an open expansion tank in the tower of the city hall (at an elevation of some 200 ft) which is connected to the return line of the heating system. There is a reserve expansion tank in the power plant; it consists of a closed vessel in which the pressure can be produced by compressed air or by steam. The circulating pump is in the return line.

The heat supplied by the municipal system is delivered to office buildings, hotels, residences, laundries, etc., but not to factories. The heat is transferred to the consumers by means of heat exchangers because only comparatively warm water is needed by the consumers; in a few cases, however, hot water from the central system is discharged or sprayed directly into the secondary systems. There are certain differences between the construction of a system in which the hot water is taken directly from the boilers, and one of a type like that of the city of Dresden in which the hot water is taken from heat exchangers.

Whenever a municipal heating system is designed in Germany it is customary to combine the heating system with a power system in order to use the energy of the fuel as completely as possible. In such cases, the circulating pump is placed in the return line to reduce the danger of the formation of steam and of cavitation. In addition, this arrangement has the advantage that the entire heating system is subjected to a lower pressure than is the case when the pump is placed in the flow line.

The expansion tank is placed on the suction side of the pump and at such an elevation that even at low pump pressure—for example, at nights—the pressure in the flow line is still high enough to prevent the formation of steam in the heat exchangers.

DR. PAUL RESCHKE, consulting engineer, Dresden, Germany, comments on the use of high pressure hot water systems—and particularly the Dresden municipal system—in this "report" which has been translated by F. E. Giesecke, consulting engineer and member of HPAC's board of consulting and contributing editors. In several articles by I. R. Kell (and discussion by Paul L. Geiringer) published in HPAC during 1948, the fundamentals and details of employing high pressure, high temperature hot water for process and space heating requirements were explained

Advantages of Hot Water

With reference to the advantages and disadvantages of a hot water system, I should like to make the following remarks:

1) When the capacity of a hot water system must be increased either because additions are to be made or because extremely low temperatures are experienced, it can be done by raising the temperature of the water in the flow line or by increasing the rate of flow of water through the system by substituting a pump of larger capacity. It is thus evident that a given hot water system has a large reserve capacity. I can, therefore, not agree with statements that it is difficult to make additions to a hot water heating system; that can only be the

case when the system is small and when the pipe lines are of very limited size. A municipal heating system must always be made of ample size when first designed so that new additions can be made with little difficulty. This may also be a fundamental difference between a municipal heating system and a hot water system for single buildings.

Can Be Heated Up Rapidly

2) A hot water heating system can be heated up very rapidly. In the Dresden system, the most distant consumer (two miles away) can be supplied with water of the highest temperature in 20 min. This is accomplished by placing a cross connection between the flow and the return line at the extreme end of the line. When necessary, the pump pressure can be raised to such an extent that the cross connection valve opens automatically and the hot water flows directly from the flow line into the return line, so that the water circulation through the entire system is increased. But since the hot water system cools only slightly during the night, this precaution is only seldom necessary.

3) A particular advantage for manufacturing processes is that the temperature of the water in the flow line can be regulated very accurately and can be varied according to necessity; for example, by mixing water from the return line to the flow line.

It may also be of interest to note that the metering of heat is very important in Dresden. The rate at which heat is delivered to the consumer is measured by meters which automatically record the consumption of heat in thermal units. These meters record continuously the product of the rate at which water is being delivered to the consumer with the temperature drop which takes place in the water as it flows through the consumer's system.

The static pressure in the Dresden central hot water heating system is produced by an open expansion tank, in the tower of the city hall, which is connected to the return line. There is a reserve expansion tank, in the power plant, which consists of a closed vessel

Building Engineer Learns System During Installation

TIMELY TIPS on what to expect and how to prepare for the problems involved in opening a new office building were given in an article by George N. Posey, manager of the City National Bank building in Houston, in an article in Skyscraper Management, which is published by the National Association of Building Owners and Managers. A description of the air conditioning of this building was given in the article by Robert J. Salinger, of the office of Reg. F. Taylor, the consulting mechanical engineer, in the February 1948 issue of HPAC.

The following paragraphs are quoted from Mr. Posey's article:

"It wasn't long before we knew that our building would open 100 percent occupied, so that it would be necessary at the opening of the building to have a full crew in all of our departments. Four months before we began moving tenants in, we employed our first operating employee. He was the chief engineer, and although the contractors were in the middle of installing the mechanical equipment in the building, we decided that the chief engineer should come into the building so that he could record the location of every fan, motor, pump, and all of the balance of the mechanical equipment; and to familiarize himself with the locations of the equipment and so examine it before the major portion of it was inclosed.

"He was instructed not to interfere in the installation of any equipment in the building—that if he observed any equipment which in his judgment was being placed wrong to come to us, and we would take it up with the architect, and he would have it remedied. In that way he did not gain the disfavor of the men who were installing the equipment. He made a record of every piece of equipment in the building, showing the description of the article, and where it was placed.

"This man had been in the navy for seven years, and the government had sent him to several different schools, where he received instructions covering the operation of diesels, air conditioning, refrigeration, and many other phases of the operation of equipment similar to that used in an office building.

"Thirty days before the opening of the building, he was authorized to employ six operating engineers, and he was given the full responsibility of the maintenance and the operation of the mechanical equipment in the building."

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Air Conditioning For The Printer

UPON READING his letter on air conditioning in the printing industry, published in the January HPAC, one gets the impression that "D.S." is an experienced printing executive, that he has investigated this subject of air conditioning quite extensively, and that there is a lot of truth in what he says. For this reason, we dislike to have him say, "We have decided temporarily that the air conditioning industry today does not have exactly what we want—or perhaps it is that they have it but we can't find it."

What the air conditioning industry has to offer the printing industry is not something that was just decided upon by a group of air conditioning experts; it is what the printers themselves have thought they needed after long years of experience with and without air conditioning equipment. In other words the printing industry has, to a large extent, fixed the atmospheric conditions which are considered to be standard for the printing industry.

Anyone who has been in the air conditioning industry for any length of time knows that the contractor seldom tries to give the potential customer more than he needs; actually, the tendency may be to give him less. The tendency may be in this direction for several reasons — one of which is the thought that the larger the system the less the chance is that the prospect will buy it, and another is that with competition so keen one does not dare ask for more than is thought to be enough.

"D.S." says that they are looking for an air conditioning system that accomplishes the results in moderation. That seems like a logical way to approach the problem and I believe one can get moderation in the standard system. Perhaps he overlooks the point that even though these things are done in moderation, a large plant will require a large system.

A lot of energy is required to remove moisture from the air in order to maintain a constant relative humidity, just as a lot of energy is required to put the moisture into the air—like boiling water on a stove. If 1000 Btu's are required to change the water into vapor, then the same amount of heat is required to change the vapor back into water. It is rather astounding when one calculates that the energy required to condense a pint of water is sufficient to raise a 150 lb man one mile in the air.

No one can disagree with the statement that a temperature reduction of 20 deg is sufficient. Most applications for this particular industry would not require more than a 15 deg reduction. Few printers want a temperature less than 75 deg and most of them are satisfied with 80 deg as a minimum. A 10 deg reduction is hardly enough—for several reasons. A 10 deg reduction at 95 deg outside gives 85 deg inside, which may be all right at the high outside temperature of 95 deg but won't be all right when the outside is 85 deg or 80 deg. And a standard system that is designed to maintain a 10 deg reduction at 95 deg won't maintain a 10 deg reduction at a lower outside temperature, such as 85 deg. So at times, during the cooling season, the inside temperature will be higher than the outside temperature—and employees won't be happy about this. Furthermore, it is decidedly better to maintain a summer temperature that can be carried on throughout the winter—such as 75 deg.

Within certain limits, a constant relative humidity is much more important than the exact amount of the relative humidity. Most of the trouble comes when the relative humidity varies from one extreme to the other.

Regardless of the point at which the relative humidity is maintained, it is always important, of course, to have the incoming paper conditioned so that its hygrometric condition corresponds closely to that of the relative humidity maintained in the pressroom.

It is difficult to believe that any lithographer without air conditioning can operate without having trouble of one kind or another on more than 10 to 25 days a year. Could it be that "D.S." is thinking of just one season of the year? This is a year 'round problem and trouble can be experienced in winter, summer, spring and fall. For instance, rollers are affected in the summertime by high temperature and by high humidity; in the wintertime, the low humidity causes them to dry out too much, leaving the surface hard which distributes the ink poorly. There are probably just as many things which cause trouble in the winter season as there are in the humid summer season.

Here is a partial list of the things that can cause trouble throughout the year:

Summer	*Winter*
High temperature	——
High humidity	Low humidity
Soft rollers	Hard rollers
——	Static electricity
Wavy paper	Buckled paper
Curling paper	Curling paper
Misregister	Misregister
Ink	Ink
Offset of ink	Offset of ink

We believe "D.S." can find a reliable contractor who will furnish a system to do things in a moderate way but we can't be sure that even this procedure would result in a small system. The actual size of the equipment and its cost is going to depend upon the magnitude of the plant.

Looking at it squarely, one doesn't buy air conditioning equipment anyway. One buys the results which the equipment merely provides—the conditions which eliminate all of the variable factors due to the weather.

These results are somewhat intangible in the beginning. Actually air conditioning for the printing plant must be sold largely on the engineering ability of the seller and bought largely upon the faith of the buyer—faith not only in the seller's engineering ability but in his business integrity.

A clear understanding of the principles involved in scientific air conditioning is of the utmost importance to the prospective purchaser because the more completely he understands the somewhat complicated factors of its scientific application, the more easily he will appreciate the necessity of having equipment scientifically designed to accomplish specified results in the most economical manner, rather than equipment designed primarily to meet a price.—H.W.

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Practical Pointers on Reader's Problem of Exhaust Ventilation

"Help!" says the builder of a roller skating rink where difficulty in expelling air is causing trouble. Mr. Lewis devotes his "page" this month to answering the specific question, and takes the opportunity to discuss other ramifications of the subject—including a plant where 15 hp was used for months to draw air in one side of a monitor and discharge it back outdoors through the other side

I HAVE received a request for help from a builder of a roller skating rink. There are five small windows, each 30 in. x 16 in., along the sides of the room, spaced about 10 ft apart. There is a standard 36 in. door and one 30 in. x 16 in. window at each end of the room. The bottoms of the windows probably are about 8 ft above the floor.

The roof is carried on bow string trusses which are 7 ft high at the center. There is a flat ceiling at the truss-bottom level, made of fibrous insulating board. The ceiling is only 10 ft above the floor.

There are two warm air furnaces in small rooms, one at the northeast corner and one at the southwest corner of the rink.

Due to the curving roof, there are no walls in the attic except at the north and south ends. In each of these walls there are five portholes each of about 1 sq ft area, fitted with horizontal louvers. The prevailing wind is parallel with the longer axis of the building.

"Ventilating Is a Great Headache"

The builder comments as follows: "We cannot expel the air from this building. The ventilating is a great headache. We installed two 36 in. suction fans in the ceiling in an attempt to withdraw the dust as well as the smoke from the room. However, the shutters on the fans fail to open even when the fans are operating at top speed. We have suggested blowing the dust and air directly out of the building instead of into the attic."

This skating rink is very large in plan in proportion to its height and the windows seem unduly small. Presumably there are no air distributing ducts extended from the two furnaces in the diagonally opposite corners of the rink. No information is disclosed as to whether these furnaces have electric fans or as to whether there is any provision for introduction, through the furnaces, of new air from outdoors.

There is no explanation given as to why there should be any particular amount of smoke in a skating rink—presumably there are many tobacco-burning spectators. I hope to be reassured as to whether there is an adequate fire resistant chimney for each furnace. It can be suggested that if the furnaces did not have good chimneys and if the exhaust fans were potent, they could very well cause smoke from the furnaces to enter the rink.

Expelling Smoke and Dust

Air or smoke or dust cannot be "expelled" from a closed room by exhaust fans unless there is provided an acceptable supply of properly warmed, clean, outside air to replace the air that is withdrawn.

Electric fans cannot "expel" air or smoke or dust from a room unless

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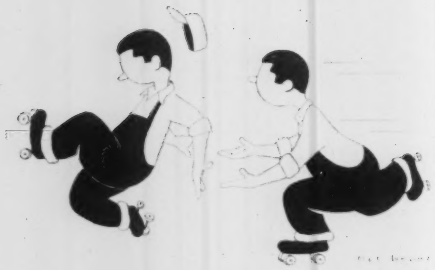


there are adequate outlets from the fans ultimately communicating with the outdoors.

The windows along the walls of this rink are not easily openable, are too small, and due to their elevation, there is little tendency to change the air over the large areas in the room that are remote from the windows. If the two furnaces had individual electric fans forcing air around them, this air coming from outdoors, and if the air were distributed to at least some extent along the long outside walls the trouble would be less serious.

Even if the two exhaust fans could obtain the designed volume of air from the apparently tight room they could discharge it only into the attic. The attic has five little openings in the north wall and five little openings in the south wall. What air blows in through the north wall must escape through the south wall, leaving no particular temptation for whatever air is delivered by the exhaust fans to escape anywhere. Air escape openings in walls, particularly when obstructed by louvers, are of little use.

One Fan Takes Air From Another

I remember visiting the very large general offices of a big company that had an elaborate and costly air supply system, and employed mechanical refrigeration to cool the air in warm weather. I was asked to find out why the place smelled and why the air movement seemed sluggish.

I found that the outlet for spent air was in a cupola or monitor above the roof of the top story. They had two big exhaust fans up there, one blowing out through the east wall and one blowing out through the west wall. Both took suction from a single large metal duct that was supposed to pick up odorous and too-warm air through ducts from the four stories of offices.

I found that one of these fans was not running and that it hadn't been operated for many months. The maintenance man—rather, the alleged maintenance man—claimed that operation of more than one of these big fans would be wasteful of power and sinful as to waste of lubricating oil, even though both fan outlets were open to the atmosphere. I had no trouble in showing the executives that when but one of two such fans, so located, is operated, it no longer exerts suction on the long exhaust ducts coming from the building but takes all the air it needs through the other fan in reverse direction.

At this plant, therefore, they had spent 15 hp for months merely to draw outside air in from the east side of the monitor and to discharge it outdoors through the west side.

In the skating rink, one of the 36 in. ceiling fans could be blowing the air back into the room through the other one.

Another precept might well be suggested: Even though the fan may be of the centrifugal type with backward curved blades, it is preferable to install a single unit either for air delivery or exhaust, rather than to install several fans in parallel if all are working on the same duct system. If one of these teamwork fans doesn't run, and if its airway is not closed tightly, there will be disappointment about the work done by the remaining fan or fans.

HOTEL IN TROPICS HAS HEATED DANCE FLOOR

The first radiant heated dancing pavilion to be built in a tropical country is under construction at the Hotel Puerto de Montana near Jarabacoa in the Dominican Republic, according to the Dominican information center. Located 2750 ft above sea level, the tiled floor of the pavilion is laid over convoluted hot water pipes. The temperature in the Cordilleras mountains of the Dominican Republic fluctuates between 55 and 65 deg in the summer; so cool that wheat, apples, quince, barley, pears, and cherries are grown on nearby haciendas.

The hotel is of ranch style architectural design. It is located in a landscape of pine trees and natural rock springs, with an unsurpassed view of the 10,000 ft Pico Trujillo—highest point in this hemisphere east of the Rocky Mountains.

CONCEALED UNIT COOLS HOTEL SUITE

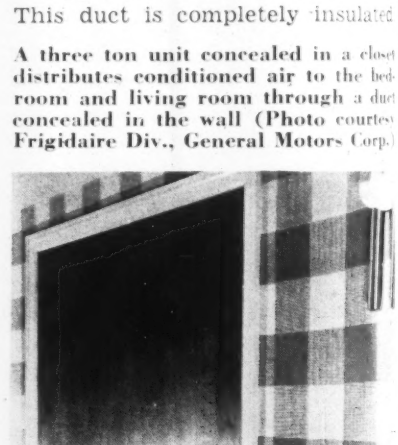
Installation of packaged air conditioning equipment to provide the "built-in" look in modern hotels, restaurants, and other establishments is relatively simple if a little imagination and ingenuity are used.

A good example can be found in the Dayton Biltmore hotel, where a 3 ton unit was installed in a large corner suite by the Refrigeration Equipment Co.

The air conditioning unit proper is housed in a clothes closet off the entrance alcove of the suite, which is comprised of a living room, bedroom, and bath. Installed facing the doorway of the closet, the unit is completely hidden by a stained plywood panel which replaces the door itself. The return grille of the unit extends through the panel and a small recess below holds the control switch.

Inside the closet, all piping and electrical connections remain hidden from the view of the suite occupants. The conditioner was installed without its air distribution hood; instead, it is connected to a short air distribution duct about 20 ft in length, installed between the walls of the living room and bedroom. Discharge grilles near the ceiling serve both of these areas. This duct is completely insulated.

A three ton unit concealed in a closet distributes conditioned air to the bedroom and living room through a duct concealed in the wall (Photo courtesy Frigidaire Div., General Motors Corp.)



Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Permeance Measurement Improved by Special Cell

By F. A. Joy* and E. R. Queer**, State College, Pa.

SUMMARY—A new apparatus for measuring the water vapor transmission of materials is described. Thick specimens as well as papers can be accommodated, and the panel size, 12 in. in diameter, is large enough to be a true sample of most permeable materials. Its unique features include the maintenance of different temperatures when desired on the two faces of the test panel, and vapor pressure control on each face at any chosen value in a wide range. Air movement may be provided over both faces of the panel.

THE PROBLEMS of *humidity* in their relation to comfort, process, or storage are a major concern of air conditioning engineers. Packaging engineers choose envelope materials which retain moisture in bread and exclude it from salt, and the packaging of living spaces is being given more attention. Fundamental to these considerations is the rate of moisture transmission through materials—paper, paint, wood, etc.; the determination of this rate for each material, *i.e.*, its *permeance*, is the first step in solving such problems.

On a basis of unit time, unit area and unit vapor pressure difference, the rate of water vapor transmission through any specific thickness of a material is its *permeance*. Another term, *permeability*, has frequently been used in this application but such use is unfortunate. Permeability should be applied only to a unit thickness of the material, and when so used it becomes a distinguishing characteristic of the substance—one of its physical properties. As an illustration, the permeance of a wood plank is only a small fraction of the permeance of a shaving cut from it, yet their permeabilities are the same. This use of terms is consistent with the established practice in the thermal field where conductance relates to a particular piece of material or combination of such pieces. Conductivity relates to a unit thickness of a material. In electricity a similar use of terms has also been established. Likewise, the vapor *resistance* of a specific piece of material is the reciprocal of its permeance, just as resistance to heat transmission or electricity is the reciprocal of conductance. *Resistivity* to water vapor is the reciprocal of permeability and likewise applies to a unit thickness of the material, just as the same term is applied in the other fields.

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Methods of Measurement

Many devices have been used for the measurement of water vapor transmission. The smaller sizes are usually called *Vapor transmission cells* or simply cells and in their simplest form consist of a cup or dish over the top of which the specimen is sealed. If the cup contains water, and is placed in a dehumidified space, the method is called the wet method. If it contains a desiccant, and the surrounding space is humidified, it is called the dry method. In either case the vapor transmission through the permeable specimen is determined by periodic weighing of the cell.

Many variations of these basic designs have been developed differing in size of the specimen and the manner of its attachment to the top of the cup. Sealing with waxes is most common but pressure seals are also used. Air circulation over the external surface is usual and it has sometimes been attempted within the cell.

Four tentative standards have been approved by the *American Society for Testing Materials*. D988-48T, also known as the *Tappi Method*, applies to paper, paperboard, and other sheet materials and is

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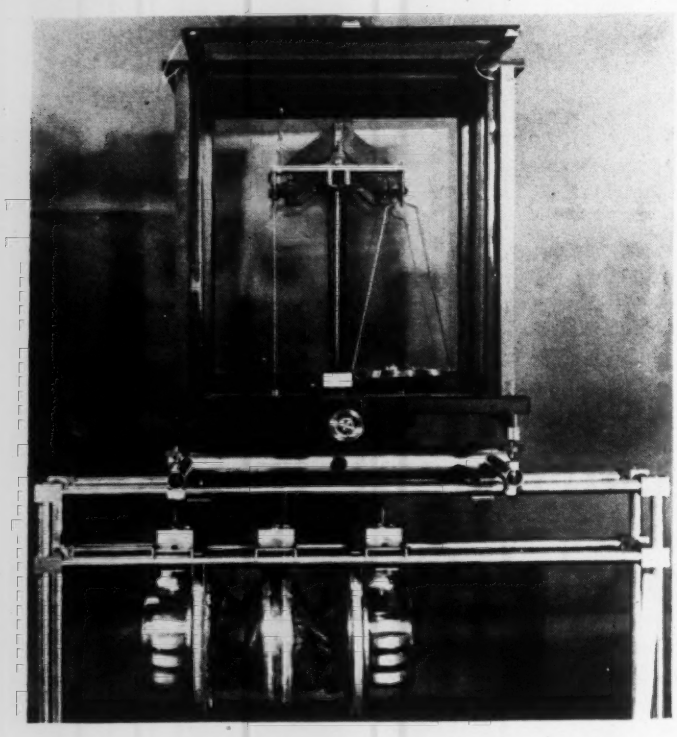

Fig. 1—Water vapor transmission cell—Model 1

essentially a dry method. C214-48T, applicable to vapor seals up to $\frac{1}{8}$ in. thick, used in connection with thermal insulation, approves either the wet or dry method, with the warning that the results *should not be compared*.

All such methods are naturally isothermal, the vapor pressure difference across the specimen being due to the difference of relative humidity inside and outside the cell. Other devices have been developed which provide a temperature difference across the specimen. They are applicable to thicker materials and are naturally of larger dimensions and less simple. They apply especially to the testing of building materials for which a temperature difference is the normal service condition.

An outstanding feature of the many methods in use is the disagreement of their results. This disagreement is especially evident when results obtained by the *wet* and *dry* methods are compared and therefore a statement of the method used is necessary. Accumulating evidence indicates that the rate of water vapor transmission through some specimens depends not only upon the vapor pressure difference, but also upon other factors such as relative humidity and temperature, as well as air movement over the surfaces.

To overcome some of the limitations of the simpler methods and especially to provide a means for testing thicker specimens, a project at the Engineering Experiment Station of The Pennsylvania State College was initiated in 1944.

Double Cup Cell

At the outset it was decided that the apparatus should combine the good features of both wet and dry methods, using two cups between which the specimen could be sealed. This arrangement, while still requiring constant ambient temperature, eliminates the need for humidity control of the atmosphere surrounding the cell. It greatly reduces the problems of entrance into and necessary work within that space, or the alternative of remote handling of cells for weighing purposes.

On the other hand, the double cup cell presents other weighing problems. No longer is the changing weight of the whole cell a measure of water vapor transfer. In the new arrangement there is no change in weight of the whole cell. Instead it is necessary to provide within one cup or *chamber* (as hereafter designated) a water pan, and within the other, a desiccant pan.

The loss in weight of the water is the weight of moisture entering the specimen, and the gain in weight of the desiccant is the weight of moisture leaving the specimen[1]. If the specimen is hygroscopic, these weight changes will not at first be equal while the specimen is adsorbing or giving up moisture in an approach to equilibrium, or a *steady state* condition. When a steady state is established, the water loss and the desiccant gain are equal.

The *equality of inflow and outflow rates* as an indicator of a steady state *is fundamental to this test method*. Inequality, on the other hand, has two possible interpretations: (1) a steady state is not reached, or (2) the cell is not tight and moisture is entering or leaving the cell[2]. The opportunity to make two separate determinations of the weight of water vapor transmitted is a unique feature of the two chamber design and possesses marked advantages in the detection of errors in data or malfunctioning of the apparatus.

Accompanying these manifest advantages is the problem of weighing the water and desiccant pans periodically without removing them from their respective chambers. In the first preliminary design (Fig 1) this problem was solved by suspending each pan (actually a set of 4 pans) from a rod entering the chamber through a rubber bellows. At the top end, each rod was hooked for attachment to an analytical balance movable on suitable rails to allow accurate positioning above each of its loads. The rubber bellows was promptly found unsatisfactory, however, as it reduced the

[1] This statement is not quite true during the first hours of a test while the chamber walls are adsorbing or giving out moisture in their approach to an equilibrium with the adjacent atmosphere.

[2] A third possibility is a variation of No. 2, namely: that moisture is condensing on the chamber surface—an eventuality in the *wet* chamber at high relative humidity. A fourth possibility—chemical reaction—is eliminated by constructing the cell of non-corrodible materials.

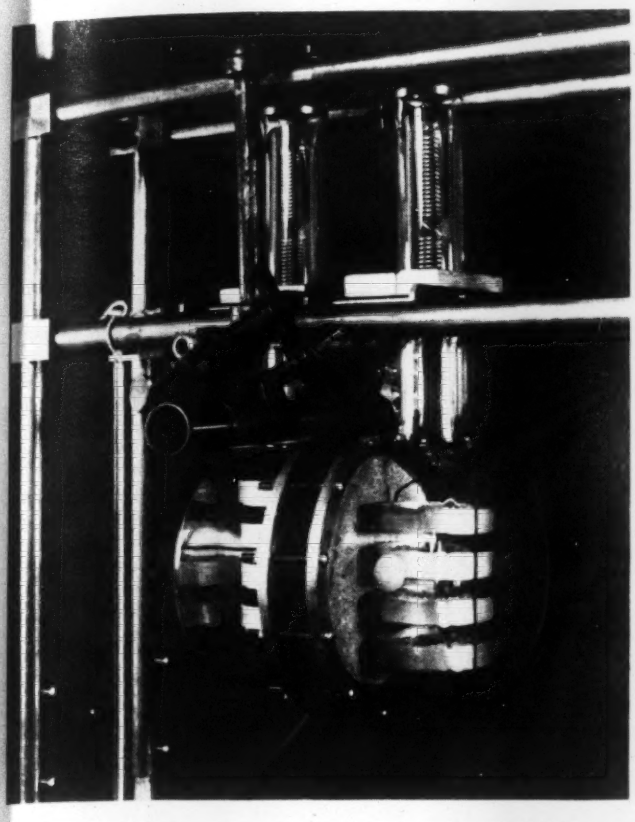

Fig. 2—Water vapor transmission cell—Model 2

Fig. 3—Water vapor transmission cell—Model 3

precision of weighing and was not impervious to water vapor. A liquid seal was also tried using kerosene but its buoyancy and evaporation were objectionable.

A feature also attempted in this first model was the periodic weighing of the specimen itself as a further check on its water adsorption. Flexible plastic sleeves attached the specimen ring to each chamber as shown in Fig. 1, but for the same reasons that had discredited the rubber bellows this arrangement proved impracticable and the attempt to weigh the specimen was abandoned in later models.

In the second preliminary design, Fig. 2, a new method of weighing was used. Each set of pans was supported by calibrated iso-elastic springs enclosed within a glass tube which formed an extension of the chamber, sealed at the top. The helical springs were arranged in pairs, one being wound opposite to the other so that their stretching produced no rotation of the load. This was necessary since the link between load and spring was a graduated scale whose position was sighted with reference to the cross-hair in an externally mounted microscope. A change in the scale position could be converted to weight by means of the spring constant which was 770 grains per inch. The specimen as shown in Fig. 2 was clamped between the wet and dry chambers with wax used to seal each face to its adjacent chamber and also to seal the rim of the specimen which was otherwise exposed. Some edge leakage was promptly indicated and required correction, but this model was a long step toward a satisfactory design.

The next design, Model 3, is shown in Fig. 3, and in the sketch (with a few adjuncts and separated chambers) in Fig. 4. Twelve such cells have been built and are being used with satisfaction especially in the testing of vapor barriers. The improvements provided in this design include: (1) a steel band enclosing the specimen, (2) heavier and longer springs, (3) larger specimen area, (4) means to measure relative humidity in each chamber, (5) table support, and refinements.

The chambers are brass castings having glass windows gasketed with neoprene. The specimen is fitted and sealed within a 12 in. diameter steel ring which may be of any desired width to accommodate a thick or thin specimen. The ring edges are machined, and the ring rather than the specimen provides the contact surfaces when the test assembly is clamped between the two chambers.

The glass columns enclose springs that combine a high initial loading with a satisfactory spring constant, 1952 grains per in., and a load carrying capacity of 3½ lb. The importance of high load capacity applies especially to the dry side and will be discussed later.

Through the cell window in Fig. 3 is seen the desiccant container, made of aluminum with perforated sides. Fig. 4 shows the water containers—two shallow glass dishes stacked one above the other to provide a water area of 18 sq. in. Glass permits the use of saturated salt solutions, the choice of salt provid-

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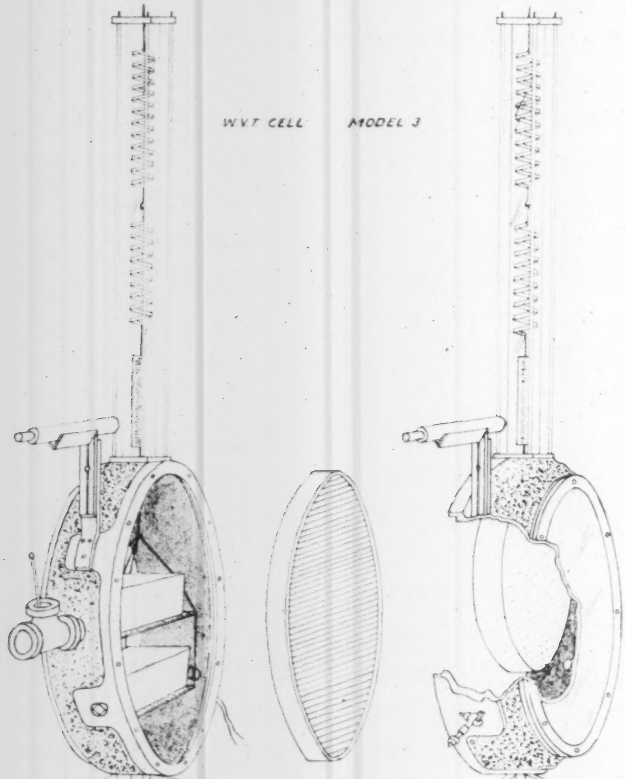

Fig. 4—W.V.T. cell—Model 3 and test specimen in ring

ing a means of adjusting in a limited range the wet side relative humidity. An adjustable tripod and an adjustable microscope holder for each chamber are provided.

Determining Vapor Pressure

Means for determining the vapor pressure in each chamber are important additions shown in Fig. 4. At the rear is fitted an electric hygrometer element and at the front is a dew point cup built into the up-facing branch of a 2 in. pipe tee. The cup is supported in an adapter made of ½ in. plate lucite, a material which provides the necessary heat isolation for the cup and good vapor integrity for the chamber. In the front of the tee, a window is fitted for observation of the polished cylindrical cup. Plate lucite is again used for easy machineability and fitting into the pipe threads.

The dry side dew point cup is usually cooled by dry ice in an alcohol bath while the wet side usually requires only the insertion of a chilled metal rod into the water it contains. The bath is allowed to remain in each cup between observations but both cups are stoppered. Avoidance of evaporation from the wet side cup is especially important since its lowered temperature is apt to produce a continued condensation within the cell.

In the set-up of a test it is desirable to test the tightness of the closure to air pressure. A stop cock in each chamber and suitable rubber tube fittings provide a means for raising the pressure (with a hand pump) in both chambers simultaneously to about 1 in. Hg. Experience indicates that absolute tightness is not important but gross leakage should be avoided.

This design has been used with satisfaction in the tests of many specimens, such as sheet vapor barriers for building construction and paint coatings, whose permeance (under the test conditions) was less than 5 grains per (square foot) (hour) (inch of mercury) or *Perms*.

The weight of water vapor transferred through a particular piece of material is undoubtedly proportional to the area, and to the time duration of the transfer, but it is frequently not proportional to the vapor pressure difference across the panel. Nevertheless the practice of relating vapor transfer to vapor pressure difference is well established and useful. When expressing permeance in *grains per (square foot) (hour) (inch of mercury)* it is important to note that the number so obtained is a measure of permeance in the particular situation. If the situation involves a pressure difference of 1 in. Hg, the description of the measurement does not imply that this number of grains would be the weight of vapor transferred if the pressure difference were 1 in. Hg. The validity of such an implication would require that the permeance be constant which, for many materials, it is not.

In any event, this unit *one grain per (square foot) (hour) (inch of mercury)*, although convenient to use, is a bit unwieldy to write or talk about, and it is therefore proposed that the brief designation *Perm* be the name applied to it. This name has been used in the text.

If the specimen has a higher transmission rate, the vapor resistance of the air paths from the water surfaces to the test panel on the wet side and from the panel to the active desiccant on the dry side constitute too large a portion of the whole resistance. As a result the vapor pressure is not uniform over the whole surface of the specimen on either side, and its measurement is uncertain.

Another limitation, significant only in the testing of a specimen of higher permeance, is one which is characteristic of the dry method. Since the vapor pressure in the dry chamber rises steadily as the desiccant adsorbs water, a steady state for hygroscopic specimens is technically unattainable. This rise, however, is minimized by the use of a large effective quantity of desiccant. Moreover, the slight rise that occurs in the testing of specimens of low permeance such as vapor barriers or painted panels may properly be ignored.

These facts are illustrated in the following examples which are actual tests made with the Model 3 cell.

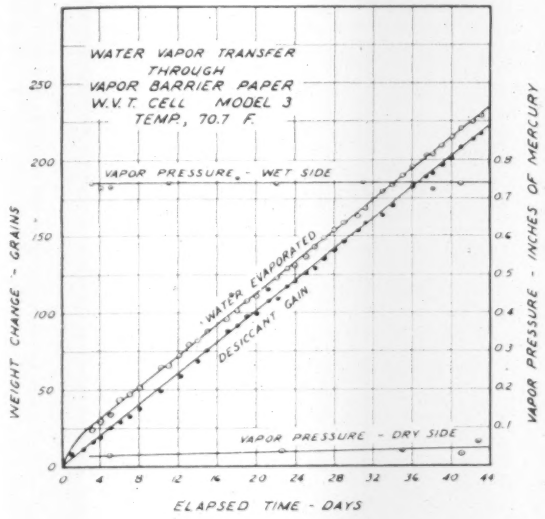
WATER VAPOR TRANSFER THROUGH VAPOR BARRIER PAPER
W.V.T. CELL MODEL 3
TEMP., 70.7 F.
VAPOR PRESSURE - WET SIDE
WATER EVAPORATED
DESICCANT GAIN
VAPOR PRESSURE - DRY SIDE
WEIGHT CHANGE - GRAINS
VAPOR PRESSURE - INCHES OF MERCURY
ELAPSED TIME - DAYS

Fig. 5—Water vapor transfer through vapor barrier paper in W.V.T. cell—Model 3 (temperature 70.7 F)

In Fig. 5 is shown the plot of data taken in the test of a vapor barrier *paper*—a duplex paper with an asphalt center. The daily scale readings (in thousandths of an inch) have been converted to weights using the spring calibration, 1952 grains per inch of deflection, and the results plotted as *water evaporated* and *desiccant gain*. The points lie very close to straight lines, the departure being rarely in excess of two grains which is the practical limit of scale readability.

At the start, the divergence of these lines indicates that an amount of about 12 grains of water vapor has been adsorbed by the paper and the water chamber walls in their approach to a steady state. The amount given up by the dry chamber walls and the adjacent side of the specimen (and picked up by the desiccant) is either too slight to be indicated or has already occurred before the first reading. As drawn, these lines are not quite parallel, but the divergence is only two grains in 44 days. The slowly increasing relative humidity in the dry chamber is a very slight factor but most of this two grain difference may be considered leakage. In either case, its magnitude is negligible.

The vapor pressure in each chamber was obtained by the dew point method, since the relative humidity was outside the satisfactory range of available electric hygrometer elements. The plots of these pressures also are shown in Fig. 5, and straight lines are drawn through them. On the wet side, the vapor pressure is deemed constant at 0.735 in. Hg which corresponds to 97 percent R.H. (relative humidity). On the dry side, the vapor pressure is not quite constant, the slight rise corresponding to a rise in relative humidity from 3.3 percent at the start to 6.6 percent R.H. at the finish.

This 3.3 percent increment produces a 3.5 percent reduction in the vapor pressure difference across the specimen, but its effect on the vapor transfer rate is not discernible. The choice of straight lines to represent the weight changes in effect averages the rates of transfer at the start and finish of the test, and it is therefore appropriate to use the average vapor pressure difference for the period, namely, 0.735 — 0.037 = 0.698 in. Hg.

The permeance of the specimen is computed by solving the following equation:

Weight of vapor transmitted = permeance × Area × Time × Vapor pressure difference

or

$$\text{permeance} = \frac{W}{tA\Delta p} \quad \ldots\ldots\ldots (1)$$

where

W = the weight, in grains, of the vapor transmitted
t = the time, in hours, required for the above transmission
A = the area of the specimen in square feet
Δp = the difference in vapor pressure, in inches of mercury, across the specimen

in this case,

$$\text{Permeance} = \frac{223}{(44 \times 24) \times 0.726 \times 0.698}$$

$$= 0.417 \text{ Perms}$$

To demonstrate the effects of a more substantial rise in the dry side relative humidity during the progress of a test, the results of another test in the Model 3 cell are shown in Fig. 6. In this case, the specimen (a pine wood panel 1.375 in. thick) was highly hygroscopic, and although the test was contin-

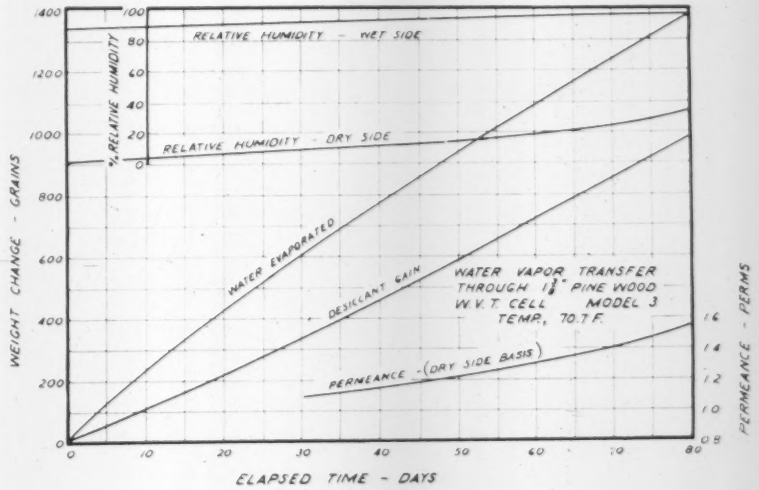
RELATIVE HUMIDITY - WET SIDE
RELATIVE HUMIDITY - DRY SIDE
% RELATIVE HUMIDITY
WATER EVAPORATED
DESICCANT GAIN
WATER VAPOR TRANSFER THROUGH 1 3/8" PINE WOOD
W.V.T. CELL MODEL 3
TEMP., 70.7 F.
PERMEANCE - (DRY SIDE BASIS)
WEIGHT CHANGE - GRAINS
PERMEANCE - PERMS
ELAPSED TIME - DAYS

Fig. 6—Water vapor transfer through 1 3/8 in. pine wood in W.V.T. cell—Model 3 (temperature 70.7 F)

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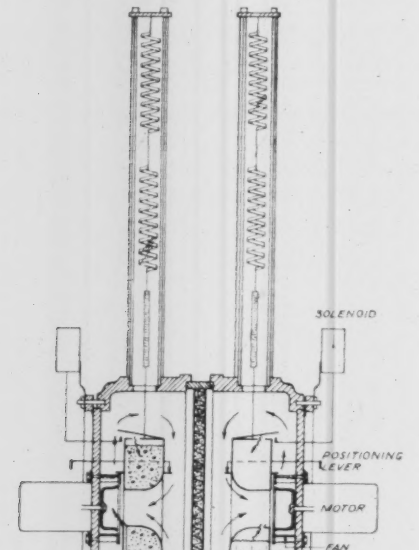

Fig. 7—Controlled humidity duplex cell—Model 4

ued for 80 days, a steady state was never reached. In fact, as already noted in these circumstances, a steady state is unattainable.

With the scales shown, the plotted points of the data are everywhere touched by the curves, and are therefore omitted from the graphs. The wide and continued divergence of the curves—*water evaporated* and *desiccant gain*—indicates clearly the increasing adsorption of vapor in the wood amounting to about 400 grains at the finish[a]. The changing curvature of each line is the result of several variations, but primarily of the changing relative humidities in both cell chambers. These changing conditions are indicated by the curves at the top of Fig. 6, the wet side relative humidity rising from 87 percent to 96 percent R.H. accompanying the dry side rise from 2 percent to 34 percent R.H. As a result, the vapor pressure difference across the specimen diminished 27 percent during the progress of the test, yet the rate of transfer was well maintained.

The explanation of this paradox lies of course in the fact that wood permeability increases greatly as relative humidity is increased. The computations of the permeance of this panel are based upon the day to day conditions and the results plotted to give the curve at the bottom of Fig. 6, the dry side weights being alone considered. From this curve it is seen that the permeance increased 40 percent during the latter 50 days of the test and was rising steeply when the test was terminated.

The permeance thus determined, in an absence of steady state, must be considered as an approximation although the error is probably not great. The test illustrates the difficulty shared in greater or lesser degree by all methods using open desiccants as the vapor sink.

Another difficulty shared in some degree by other methods, both dry and wet, has already been mentioned, namely, the uncertain vapor resistance of the air paths within the cell. However, with these limitations in mind, Model 3 is recommended in the testing of specimens whose permeance is low, if the high relative humidity on one face and the low relative humidity on the other face are acceptable conditions.

In 1948 a project was undertaken for the Office of Technical Services, U.S. Department of Commerce, which included studies of the variation in the permeability of wood with relative humidity and temperature. Tests were required in a wide range of humidity, sometimes with the high relative humidity on the side of lower vapor pressure and vice versa. These requirements necessitated a more flexible design in which both temperature and relative humidity could be set and maintained in each chamber at any chosen value. To provide these features the controlled humidity duplex cell, Model 4, shown in section in Fig. 7 and in Fig. 8, was constructed.

Temperature control in each chamber is accomplished by enclosing the complete cell in a box made of structural insulating board divided through the middle by a vertical partition pierced only by the 12 in. ring which holds the specimen. The temperature in each half of the box is thermostatically controlled and a circulating fan provides the turbulence necessary to heat transfer. The warm half is heated by electric heating elements while the cold half is cooled by admitting air from a duct in which 50 F air is continuously circulated at slightly elevated pressure. The 12 in. ring holding the specimen is a band of polyethylene ½ in. thick whose high vapor resistance and low thermal conductance make it suitable as a connection between the warm and cold chambers. In Fig. 8 two of these rings, one holding a specimen, can be seen in the right foreground. In the background are three of the insulated boxes inclosing Model 4 cells in operation.

Within each cell chamber a small 27 cfm fan is fitted, Fig. 7, its four-blade scroll serving to distribute the discharge air fairly uniformly around the periphery of the chamber. The driving motor is mounted externally with a seal provided for its entering shaft. The air turbulence set up by this fan serves several purposes, among which is the transfer of heat to or from the panel surface. The air flows radially over the specimen from the rim inward toward the center at increasing velocity in a path guided by the contour of the axially positioned desiccant (or water) container, and returns to the fan suction through a 2 in. hole in the doughnut-like container. The panel surface temperature, indicated by thermocouples, is satisfactorily uniform and constant after the heat balance of the system is established.

The relative humidity in each chamber is controlled at a chosen value. An electric-hygrometer sensing element installed within the chamber is connected to an electronic humidity controller. A second sensing element is also installed for indication only, and each provides a check on the other. These elements are extremely sensitive

[a] The possibility of leakage out of the cell is not overlooked, but has been substantially eliminated by twice checking the vapor-tight integrity of the cell.

and indispensable in this design. Their accuracy, of course, is the accuracy of their calibration which is frequently checked in a water jacketed chamber constructed for the purpose. With these provisions, the dew point cup is omitted from this model as a matter of convenience.

The water and desiccant containers are of special design, involving primarily a vapor tight can with two openings through which air may be drawn by the fan when a valve in the entrance port at the top is opened. This valve is lifted by an external solenoid which is energized through a relay of the electronic humidity controller, the mechanical connection being a simple arrangement of levers with the entrance shaft moving only in rotation. Each container is normally positioned adjacent to the fan and centered on its axis by a manual bellcrank whose entering shaft moves both in rotation and translation. The containers are released from all restraint for daily weighing.

The internal features of the desiccant can are as shown at the left of Fig. 7, the air path being downward through the bed into a small plenum from which a pipe leads to the mouth of the shaped orifice hole in the container. The very dry air entering the fan suction opening is mixed in the fan before it is returned to the chamber. This drying is intermittent, being stopped by the closed valve and the effective diffusion resistance of the small outlet tube, but the cycles of valve action are short and the cyclic variation in relative humidity rarely exceeds 1 percent total.

The water can contains features only suggested in the diagram. A vertical partition in the top is located in a plane parallel to the axis of the can and 1 in. off center to clear the entrance port. Through this port the air passes down and around the can, over the water surface and up to an outlet tube which it enters near the top of the can. This tube, like that in the desiccant can, is important as a block to diffusion when the valve is closed but for simplicity is not shown in Fig. 7.

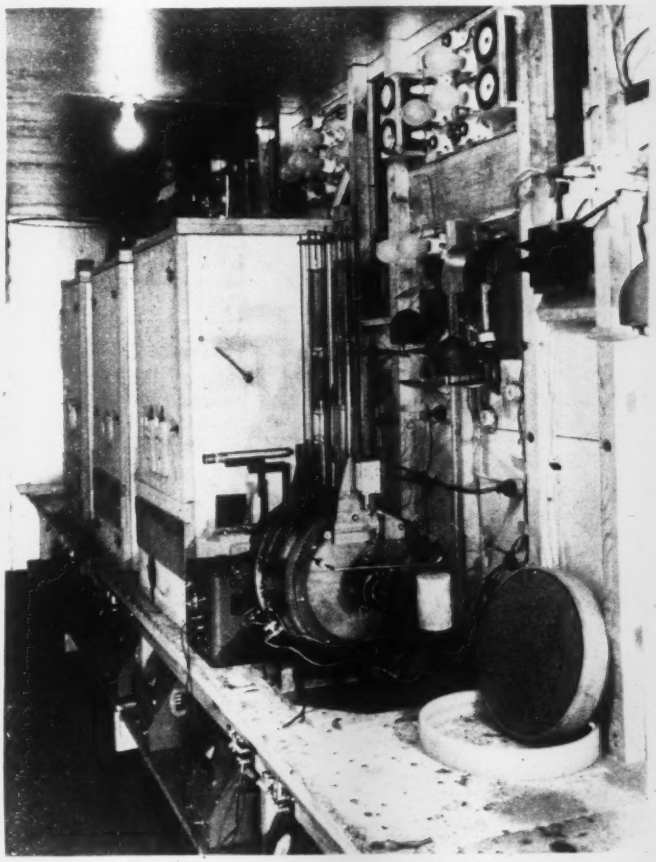

Fig. 8—Controlled humidity duplex cell—Model 4 with controlled temperature enclosures in test room

These arrangements permit a large storage of very humid air above the water and in effect allow continuous evaporation although the vapor is withdrawn intermittently as required.

Among the desirable features of this cell is positive air movement over the specimen surface. Its velocity is variable and subject to the location of the specimen surface, but ordinarily approaches a maximum of 350 fpm. Although means are at hand for providing any velocity desired, the available evidence suggests that the objective of uniform vapor pressure over the surface is attained by either velocity or turbulence, and that (for a vapor transfer up to 19 grains per hour, the maximum thus far tested), this design fulfills the requirement satisfactorily.

In respect to uniformity of temperature it is evident that a given tolerance and a given air velocity place a limit upon the temperature difference across the panel depending on its thermal conductance. In any event, the tolerance of temperature is a tolerance not of vapor pressure, but of relative humidity, and requires scrutiny only if the permeance of the specimen is sensitive to relative humidity.

Three cells of this design were built and operated for six months. Good results have been obtained in a wide range of conditions. Mean test temperatures have ranged from 50 F to 110 F with a temperature difference as high as 23 F between panel surfaces. Relative humidities on the water side have been set and controlled at values ranging from 30 percent to 93 percent while operation of the desiccant side has included humidity values from 15 percent to 77 percent. The tested vapor transfer rates have included values from 0.06 to 19 grains per hour, and the tested specimens

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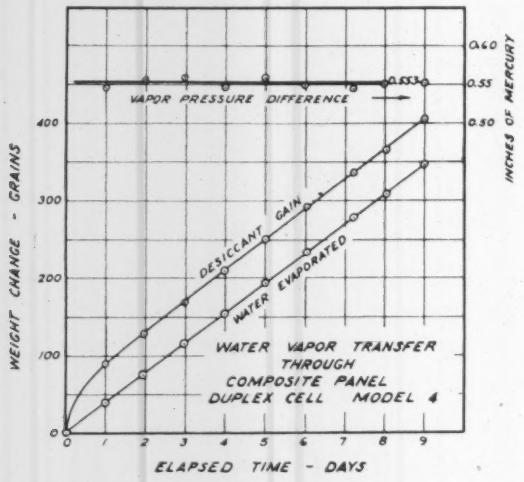

Fig. 9—Water vapor transfer through composite panel in Duplex cell—Model 4

ranged in permeance from 0.34 to 120 *Perms*.

Two actual tests are cited to indicate the nature of data and the significance of results obtained with the Model 4 cell. These tests were made on a composite panel of pine wood and insulating board, the wood thickness being $\frac{1}{8}$ in. and the insulating board about $\frac{1}{4}$ in. They were run in connection with a study of the propriety of adding the vapor resistances of these materials. In the first test the conditions on the water side were 97.6 F, 49.2 percent R.H., and on the desiccant side 73.0 F, 40.6 percent R.H., with a vapor pressure difference of 0.553 in. Hg, the panel being placed with the wood on the water side (at 97.6 F).

In Fig. 9 the scale readings have been converted to weight change (grains) and plotted as *water evaporated* and *desiccant gain*. Readings were taken daily. During the first four or five days, which were required to reach a steady state, the behavior is easily traced as the panel gave up some of its moisture content, having previously been exposed to a higher relative humidity.

In the following four days, the plotted points lie almost exactly in parallel straight lines, the indication of a steady state. From the electric hygrometer readings, the vapor pressure difference across the panel has been computed and likewise plotted. The stagger of the plotted points, amounting to 1.3 percent above and 1.3 percent below the average, 0.553 in. Hg, does not indicate a shift of conditions from day to day. Rather it is indicative of the band within which the vapor pressure difference was controlled in cycles whose length was not over one minute. The permeance of the panel is obtained as in the foregoing illustration by substituting the test data in Equation 1:

$$\text{permeance} = \frac{W}{tA\,\Delta p}$$

In this case,

$$\text{permeance} = \frac{155}{96 \times 0.66^{*} \times 0.553} = 4.4\ Perms$$

A second test on the same panel deserves mention because it illustrates the inconstancy of the permeance of some materials (in this case, wood) and the importance of choosing test conditions which are typical of the service expected of the material.

The conditions of this second test were exactly the same as the first, but the composite panel was merely turned around, so that the wood was on the desiccant side and the insulating board on the water side. The data and calculations are omitted but the permeance was found to be 13.2 *Perms*, which is three times what it was in the other position.

The explanation of this large difference is not hard to find when consideration is given to the relative humidity at the interface between the two materials. Calculations indicate that it was 22 percent in the first test, and 90 percent in the second. In the latter case the wood permeance which varies widely in response to relative humidity, was greatly increased and accounted for the three-fold rise in the permeance of the combination.

It is significant to note that in tests by some other methods this important difference would have been entirely absent or too small to attract attention.

The conclusion is thereby reached that this test method possesses distinct merit, and that both Model 3 and Model 4 have important uses. Model 3, being simple and requiring only a temperature controlled room for its operation, is the logical cell for testing materials of lower permeance which are known to be insensitive to relative humidity. The application of Model 4 is limited only by its heat transfer capacity and by the adequacy of an $11\frac{1}{4}$ in.[†] specimen as a true sample of the material tested.

Acknowledgments

The original development of this method of test was carried out with the joint sponsorship of the Armstrong Cork Co. and the Engineering Experiment Station of The Pennsylvania State College under the direction of Prof. K. J. DeJuhasz. Valuable assistance was rendered by E. Claxton, Dr. H. A. Robinson, C. C. Schrader of the Armstrong Cork Co. Research Laboratories, and Prof. F. G. Hechler, Director of the Engineering Experiment Station. F. D. Yeaple, a graduate student at the College, built the first Model 3 cells and used them in the study of water vapor transmission through holes and slots.

The Office of Technical Services, U.S. Department of Commerce, sponsored the project for which the first Model 4 cells were built.

* See footnote 4.

† The specimen diameter is nominally 11 in. when fitted in a steel ring, and is nominally $11\frac{1}{4}$ in. when fitted in the thicker polyethylene ring. The waxing technique allows variations from the nominal

Ground Temperatures as Affected by Weather Conditions

By A. B. Algren*, Minneapolis, Minn.

SUMMARY — Over a two-year period a 110 acre plot was used as a test area, and soil temperatures to a depth of 16 ft were measured by thermocouples. The soil examined was of the silt and clay type, at some points bare and at other points covered with sod. Insulating effects of the sod were quite apparent. Another interesting observation in this paper is that the ground at 16 ft is warmest in November and coldest in April. This is due to a time lag, which is described in the author's illustrations.

GROUND temperature data on the various soils for different climatic conditions are becoming increasingly important in many phases of heating, ventilating and air conditioning engineering. Some of the more recent developments for which these data might have direct application would be (*a*) the earth as a heat source for the heat pump application; (*b*) the perimeter and ground slab loss for floor panel heating systems; and (*c*) the ground losses together with floor slab temperatures for basementless houses where other heating methods exclusive of floor panel systems are used.

The tests reported in this paper were part of a two-year research project covering a field study on floor panel heating systems. The ground temperature study was made on a 110 acre plot of ground which is located at Edina, Minn., and which was selected as the site for a large residential building project.

In addition to the ground temperature data, laboratory and field tests were made on the soil to determine its mechanical analysis, percolation or permeability value, moisture content, density, specific heat and conductivity. Field tests were made on the soil for determining its density and percolation value. The mechanical analysis, moisture content, specific heat and conductivity were determined by laboratory tests on an average sample of the soil collected at depths of from 1 to 3 ft. In order that representative results might be obtained, approximately 200 lb of soil were examined.

During the first year, temperatures were determined by thermocouples inserted in test holes drilled to a depth of 8 ft. It was evident from this study that if information of practical value on ground temperatures was to be obtained, it would be necessary to take temperatures at depths considerably below the 8-ft level. At the 8-ft depth the temperature variation was approximately 21 deg from August to May. Therefore, during the 1947-1948 year, new test holes were drilled and temperatures were recorded to a 16-ft depth.

Test Holes Drilled

Ten test holes were drilled with the purpose of finding the locations in which the soil was approximately of uniform consistency throughout the depth tested. When the first several test holes were drilled, a stratum consisting of a mixture of silt, clay and about 60 percent free water was encountered at the 7-ft depths. This stratum was about 9 in. thick and was found to exist in a low lying area in the vicinity of a small pond. As all of the sod and brush had been cleared away from this area, it was decided to locate one series of thermocouples at this point.

This location provided a means for studying the effect of barren ground and also what might be called ground surface water. The thermocouple series referred to as X_n in this paper was located at this point. Other test holes showed uniform soil consistency throughout their depth. As part of this area was covered with brush and a thick, matted sod, this site was selected for the second series of thermocouples referred to as series X_s. The two thermocouple series were approximately 1200 ft apart. These two conditions provided a means for studying the insulating effect of sod.

A $1\frac{1}{2}$-in. diameter soil sampling auger was used for drilling the test holes.

The thermocouples consisted of 24 gage, copper-constantan wires with a soldered junction. The thermocouple wire was double cotton covered, enameled wire.

In order to avoid any short circuiting of the thermocouple wires due to ground moisture, the investigators encased each thermocouple in a small diameter, moisture and vapor resistant rubber tube. The end of the rubber tube at the thermocouple junction was heat sealed; each thermocouple was similarly protected from its junction to the thermocouple junction box. Preliminary tests indicated that this procedure gave adequate protection.

Each thermocouple series was completely assembled before being placed in the test holes. The ther-

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Table 1—Ground Temperatures—August 1947 to April 1948
Series X_n—Bare Ground Series X_s—Ground covered with sod

Depth below Surface (ft)	August 1947				September 1947							October 1947												
	21		2		9		18		23		30	Average		3		7		14		24		28		Average	
	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s
1	75.0	67.3	73.2	68.2	76.6	70.1	68.9	64.4	64.5	58.2	55.5	70.8	63.2	56.5	55.0	59.7	56.1	58.4	54.9	57.4	54.2	53.5	52.0	56.9	54.3
2	74.7	62.8	71.0	64.3	74.5	67.0	66.6	62.5	67.6	59.7	58.4	69.9	61.6	56.4	54.8	59.1	55.6	58.2	54.5	60.0	54.9	56.0	53.7	58.3	54.7
3	73.1	60.1	69.0	62.0	71.3	64.0	66.6	61.4	68.1	59.3	58.9	68.8	60.4	57.9	55.6	59.1	55.4	59.0	54.3	60.5	54.9	57.4	54.0	59.0	54.7
4	71.2	57.2	67.9	59.6	68.4	61.5	66.5	60.4	67.8	58.5	59.5	68.1	59.2	59.5	56.1	58.8	55.1	59.3	54.5	60.1	54.8	58.3	54.0	59.1	54.6
5	68.3	55.3	65.8	57.3	66.0	60.0	65.5	59.1	66.0	56.8	59.3	65.8	57.8	60.2	56.1	58.8	55.0	58.8	54.5	59.7	54.8	58.3	54.0	58.6	54.6
6	64.3	53.9	62.2	55.7	63.1	58.5	62.2	58.8	61.9	55.5	59.1	62.3	56.9	60.2	56.1	58.8	54.9	58.6	54.4	59.1	54.5	58.0	53.7	58.6	54.4
7	61.5	52.3	61.7	54.4	62.5	56.5	62.8	54.9	63.2	54.2	57.1	62.5	55.0	59.9	54.9	58.8	54.6	58.0	53.7	58.5	54.0	57.7	53.5	58.5	54.0
8	59.0	51.2	59.9	53.4	60.5	56.0	61.4	55.1	61.9	53.3	57.9	60.4	54.5	59.2	54.9	58.1	53.8	57.6	53.2	58.0	53.8	57.2	53.2	57.7	53.5
9	57.0	50.1	58.2	52.3	59.3	54.6	60.1	54.1	60.7	52.2	56.5	59.6	53.5	58.5	54.3	57.6	53.4	57.0	52.8	57.6	53.3	56.6	52.8	57.2	53.1
10	54.9	49.2	56.9	51.0	57.5	53.5	58.6	53.6	59.6	51.3	56.2	58.2	52.6	57.5	53.5	56.8	52.7	56.2	52.5	56.9	53.0	56.0	52.3	56.5	52.6
12	52.0	48.0	54.5	49.3	55.0	51.5	56.2	50.2	56.9	49.5	54.0	55.6	50.4	55.5	51.8	55.1	51.4	54.9	51.3	55.4	52.2	55.0	51.5	55.1	51.6
14	49.8	47.0	51.4	48.0	53.0	50.0	54.1	48.6	55.0	48.2	53.1	53.4	49.1	53.9	50.5	53.4	50.4	53.5	50.3	54.8	51.2	53.7	50.6	53.8	50.6
16	48.0	46.3	49.9	47.5	51.9	49.2	52.4	48.1	53.6	47.1	52.2	51.9	48.3	52.2	49.8	52.0	49.8	51.9	49.6	53.4	50.6	52.7	50.2	52.5	50.1
Depth of snow on ground	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean Air Temp.	85	85	74	74	84	84	78	78	60	60	42	63.1	63.1	66	66	60	60	70	70	50	50	50	50	59.2	59.2
Aver. Air Temp. for Preceding Week	78.1	78.1	71.2	71.2	76.4	76.4	63.4	63.4	62.6	62.6	48.4	....	....	51.3	51.3	61.1	61.1	60.5	60.5	60.8	60.8	54.4	54.4	....	....
Percent Sunshine	....	100	....	98	....	93	....	51	....	95	40	....	64	....	24	....	67	....	100	....	0	....	88	....	54

Depth below Surface (ft)	November 1947										December 1947					January 1948				February 1948					
	4		11		18		25		Average		2		9	18	Avg.	12	20	27	Avg.	3	10	20		Avg.	
	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_n	X_n	X_n	X_n	X_n	X_n	X_n	X_n	X_n	X_s	X_n	
1	52.1	51.2	38.4	42.3	36.8	39.8	36.0	39.5	40.8	43.2	34.8	38.5	34.8	35.3	35.0	34.1	33.0	33.0	33.4	29.5	28.0	24.8	33.4	27.4
2	53.6	52.0	44.2	46.6	40.6	42.9	39.6	42.2	44.5	45.9	37.6	40.9	37.3	38.0	37.6	35.6	34.6	34.7	35.0	32.0	31.2	31.4	35.8	31.5
3	55.0	52.7	48.9	49.7	44.3	45.5	42.8	44.9	47.7	48.2	40.2	43.3	39.7	40.2	40.0	37.4	36.6	36.7	36.9	34.0	33.4	33.2	36.8	33.5
4	55.8	53.1	51.9	51.9	47.7	48.0	46.0	47.3	50.3	50.1	43.3	45.7	42.6	42.4	42.8	39.7	38.7	38.8	39.1	36.1	35.1	34.8	38.2	35.3
5	56.7	53.2	54.3	52.7	50.3	49.6	48.7	49.0	52.5	51.1	45.7	47.4	45.0	44.7	45.1	41.8	40.7	40.9	41.1	38.5	37.4	36.8	39.7	37.6
6	57.2	53.2	55.5	53.3	52.9	50.6	51.0	50.3	54.2	51.8	48.3	48.7	47.1	46.7	47.4	43.6	42.4	43.0	43.0	40.5	39.6	39.0	41.0	39.7
7	57.2	53.1	56.0	53.4	54.1	51.4	52.7	51.1	55.0	52.3	49.8	49.8	49.1	48.3	49.1	45.1	44.0	44.4	44.5	42.0	41.4	40.4	42.0	41.3
8	57.0	53.0	56.1	53.2	54.9	51.7	53.7	51.8	55.4	52.4	51.3	50.6	50.3	49.8	50.5	46.2	45.1	45.5	45.6	43.3	42.5	41.9	42.8	42.6
9	56.6	52.8	56.1	52.8	55.1	51.8	54.4	52.3	55.5	52.4	52.2	51.2	51.4	50.7	51.4	47.4	46.1	46.5	46.7	44.5	43.8	43.2	43.5	43.8
10	56.4	52.5	56.0	52.8	55.2	51.8	54.7	52.5	55.6	52.4	52.8	51.6	52.0	51.5	52.1	48.3	47.1	47.5	47.6	45.5	44.6	44.2	44.4	44.6
12	55.3	51.8	55.2	52.2	55.0	51.4	54.8	52.3	55.1	51.9	53.3	51.8	53.1	52.7	53.0	49.8	48.6	49.0	49.1	47.0	46.3	46.2	45.7	46.5
14	54.1	51.0	54.5	51.7	54.4	50.8	54.5	52.1	54.4	51.4	53.0	51.8	53.1	53.3	53.1	50.5	49.7	50.0	50.1	48.4	47.6	47.2	46.2	47.7
16	53.2	50.5	53.4	51.0	53.7	50.4	54.0	51.9	53.6	50.9	53.0	51.5	52.6	53.7	53.1	51.2	50.4	50.8	50.8	49.0	48.6	48.5	47.0	48.7
Depth of Snow on Ground	....	....	1.8	1.8	3.5	3.5	3.7	3.7	....	....	3.5	3.5	7.1	6.0	....	2.8	5.3	5.3	....	5.0	6.5	0.4	0.4	....	
Mean Air Temp.	50	50	22	22	30	30	16	16	26.0	26.0	27	27	3	14	17.7	14	19	–11	10.0	0	10	4	4	15.6	
Aver. Air Temp. for Preceding Week	[illegible]																								
Percent Sunshine																									

Table 1—Ground Temperatures—August 1947 to April 1948 *(concluded)*
Series X_n—Bare Ground Series X_s—Ground covered with sod

Table 1—Ground Temperatures—August 1947 to April 1948 (*concluded*)
Series X_n—Bare Ground Series X_s—Ground covered with sod

Depth below Surface (ft)	2	9	March 1948 18		25		Average		6	13	April 1948 24		30		Average	
	X_n	X_n	X_n	X_s	X_n	X_s	X_n	X_s	X_n	X_n	X_n	X_s	X_n	X_s	X_n	X_s
1	31.2	31.1	31.4	33.7	31.5	32.4	31.3	33.0	40.7	43.5	53.5	41.4	54.9	49.0	48.2	47.1
2	31.7	31.7	31.5	34.8	31.5	33.1	31.6	33.9	38.4	40.4	50.0	40.5	54.2	45.6	45.7	45.3
3	32.4	32.7	32.4	36.2	32.4	34.1	32.5	35.1	36.5	39.7	46.9	40.0	51.6	43.4	43.7	43.7
4	34.1	34.3	34.0	37.9	33.8	35.4	34.0	36.6	36.2	39.0	44.6	39.8	49.0	42.0	42.2	42.6
5	36.0	35.7	35.4	39.1	35.1	36.8	35.5	37.9	36.9	38.8	42.9	39.8	46.8	41.4	41.3	41.9
6	38.1	37.8	37.2	40.4	36.8	37.9	37.9	39.1	38.0	39.0	41.7	40.2	44.8	40.8	40.9	41.6
7	39.8	39.3	38.5	41.3	38.1	38.7	38.9	40.0	39.2	39.5	41.1	40.4	44.3	40.8	41.0	41.5
8	40.9	40.8	39.5	42.0	39.4	39.6	40.1	40.8	40.2	40.2	41.1	41.0	43.7	40.8	41.3	41.6
9	42.1	42.0	40.9	42.9	40.5	40.4	41.4	41.6	41.2	40.5	41.2	41.4	43.4	41.0	41.6	41.8
10	43.1	42.8	41.8	43.8	41.4	41.1	42.3	42.4	42.0	41.5	41.7	41.9	43.5	41.4	43.0	42.2
12	45.0	44.4	43.6	45.0	43.1	42.1	44.0	43.5	43.7	43.2	42.8	43.2	44.2	42.3	43.4	43.1
14	46.3	45.8	44.9	46.0	44.4	43.1	45.3	44.5	45.0	44.6	43.8	44.2	45.0	43.0	44.4	43.9
16	47.4	46.9	46.0	46.3	45.6	43.5	46.5	44.9	46.0	45.7	45.0	44.7	46.0	43.6	45.7	44.4
Depth of Snow on Ground	8.3	7.4	....	....	0.0	0.0	....	....	0	0	0	0	0	0	0.	....
Mean Air Temp.	24	0	38	38	54	34.0	27.3	27.3	40	48	48	48	68	68	48	50	50
Aver. Air Temp. for Preceding Week	27.1	18.4	21.1	21.1	34.3	34.3	....	....	40.3	43.9	43.9	43.9	55.7	55.7	57.3	....
Percent Sunshine	....	....	5	....	80	....	66	....	....	....	100	....	72	....	0	62

mocouple junctions were accurately spaced at measured intervals and taped together as a single unit. The end of the thermocouple assembly that was to be located at the 16-ft depth was then fastened to a slip-ring arrangement at the end of a 20-ft length of steel rod, $\frac{3}{8}$ in. in diameter, and pulled taut. The rod was inserted into the test hole to the required depth, and the test hole was filled with earth and carefully tamped at intervals. Finally, the steel rod was removed.

Fig. 1 shows the thermocouple locations and the ground thermocouple junction box. Thermocouple readings, taken by a manually operated potentiometer, were read weekly for the period from August 1947 through April 1948.

Sod Provides Insulating Effect

Ground temperature readings, depth of snow on the ground, mean air temperature, average air temperature for the preceding week and percent of sunshine are shown in Table 1. The insulating effect of the sod is quite apparent. The average temperature difference between the two thermocouple series for the month of September was 7.6 F at the 1-ft depth and progressively decreased to a 3.6 F temperature difference at the 16-ft depth.

Fig. 1—Thermocouple locations (Series X_n, X_s)

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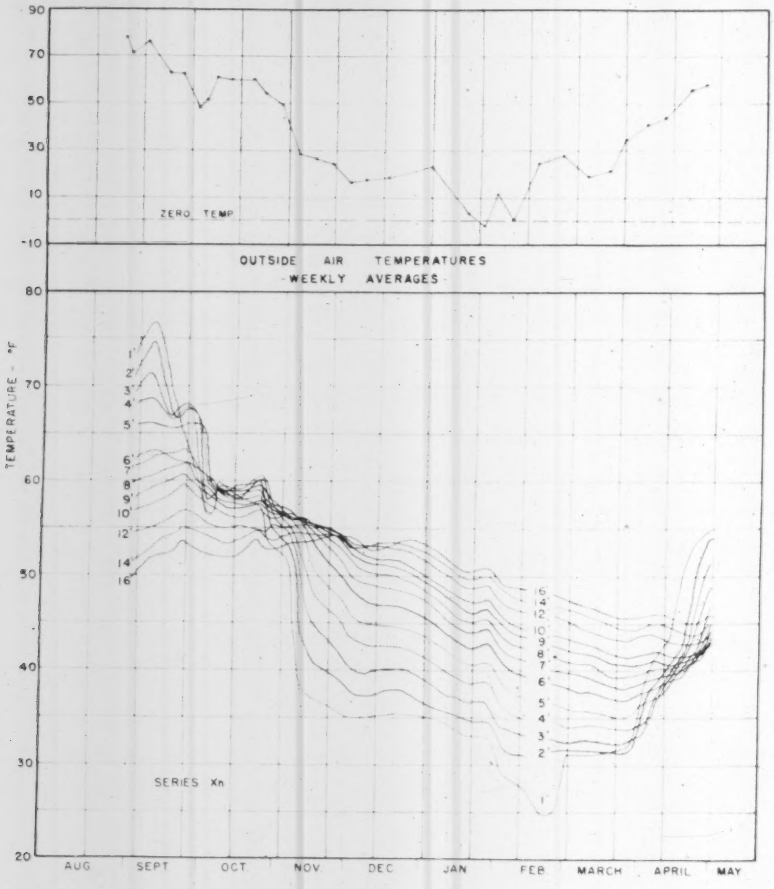

Fig. 2—Ground temperatures at different depths (August 1947 to May 1948)

During the period between September 1947 and April 1948 the series X_n thermocouples were more readily affected by the air temperature than were the X_s series. This was undoubtedly due to the insulating effect of the sod on the X_s series. Likewise, for the 1947-1948 season, the frost line depths for the X_n and X_s series were about 3 ft and 1 ft, respectively. This should not be interpreted as the maximum frost line depth for this locality; for during the 1947-1948 season, air temperatures below zero degrees were infrequent and temporary when they did occur.

The test data for the X_n series from Table 1 is shown in graph form in Fig. 2. Ground temperatures at the 1-ft level lag approximately three weeks behind the air temperature, but have approximately the same characteristic curve. The temperature at this depth varied from 76.6 F on September 9, 1947 to 24.8 F on February 20, 1948. As temperatures were read weekly, the curves of Fig. 2 do not necessarily represent the maximum or minimum temperatures that occurred during the test period.

Fig. 3 shows the ground temperature variation for the X_s series from August 1947 to December 1947. Although these temperatures are consistently lower due to the insulating effect of the sod, they follow the same general characteristics as the curves of Fig. 2.

Fig. 4 shows the monthly variations in ground temperatures for 1947-1948. Average monthly temperatures were used in plotting the curves and therefore are not the lowest recorded temperatures for the various depths. The variation at the 1-ft depth was from 75 F to 27.4 F and at the 16-ft depth from 53.6 to 45.7 F.

If the ground were to be used as a heat source for a heat pump installation and a continuous heat source temperature of 45 F were required, the curves indicate that it would be necessary to go down to a depth of 14 ft before this condition could be obtained. Some indication of the time lag for this soil can be obtained from these curves. The maximum effect of the air temperature during August does not occur until November at the 16-ft depth—a time lag of three months. Likewise, the minimum temperature due to lower air temperatures does not occur until April.

The curves of Fig. 5 show the minimum winter ground temperatures, the maximum summer ground temperatures, and the average ground temperatures at the various depths for 1947-1948. The plotted test points show a reasonably smooth curve. If these curves are extended it will be noted that they tend to approach a common temperature. At the 28-ft depth the difference in temperature between minimum winter and maximum summer is approximately two degrees. The average temperature at this depth is about 50 F. This appears to be both consistent and

Table 2—Test Report on Soil Sample[a]

	Sample 1	*Sample 2*
	Mechanical Analysis	*Percent*
Silt	54.6	48.9
Clay	16.4	14.3
Sand	29.0	36.8
	Physical Constants	*Percent*
Moisture, field conditions	23	26.1
Density, field conditions	118.2 lb per cu ft	108.4 lb per cu ft
Density, dry basis	96.1 lb per cu ft	86.0 lb per cu ft
Specific gravity	2.64	2.65
Percolation	5 min	6 min

[a]Tests conducted by Prof. Miles S. Kersten at the Engineering Experiment Station, University of Minnesota.

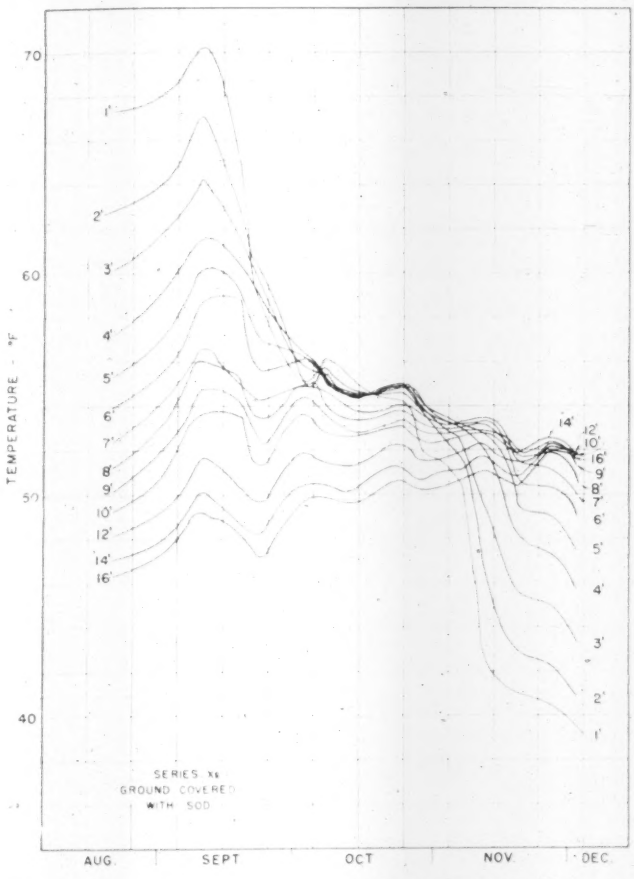

Fig. 3—Ground temperatures at different depths (August 1947 to December 1947)

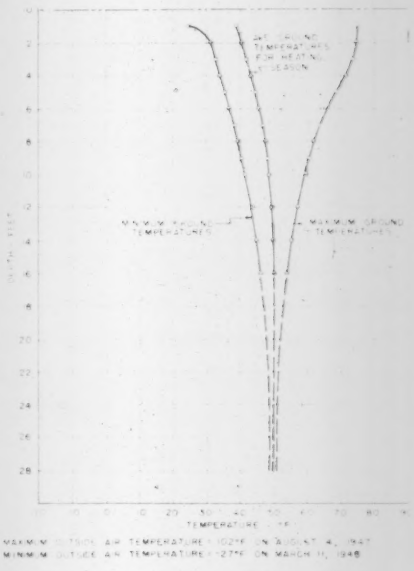

Fig. 5—Differences in ground temperatures 1947-48

reasonable as the temperature of the Artesian water supply in this locality is between 48 F and 50 F.

Although the test data included in this paper deal only with one soil, an analysis of the classification of various soils would indicate that for practical purposes moist soils could be included in the following general classifications:

1. *Sandy soils:* soils with 50 percent or more of sand and gravel content (particle size is larger than 0.05 millimeters).

2. *Silt and clay soils:* soils containing less than 50 percent sand and gravel.

The soil referred to in this paper would come under the general classification of silt and clay soils.

The ground temperatures reported would not be of much practical value without additional information on the soil itself. To obtain this information, both laboratory and field tests were made. Two samples of soil were examined: *Sample 1*, taken between a 2- to 3-foot depth; and *Sample 2*, taken between the 1- and 3-ft depth. Results are reported in Table 2.

For the conductivity tests, the average dry density of the two soil samples was used. The soil to be tested was first mixed to the desired moisture content and then compacted into the container at the desired density. The containers were sealed at both bottom and top to prevent loss of moisture. Table 3 gives the results of conductivity tests.

The test results indicate that the thermal conductivity of the soil above the freezing temperature increased only slightly with an increase in mean temperature for constant density. Likewise, for a moisture content up to 16 percent, the thermal conductivity does not vary appreciably in a mean temperature range of from +25 to -20 F. For the low moisture content (2 to 9 percent) the conductivity is

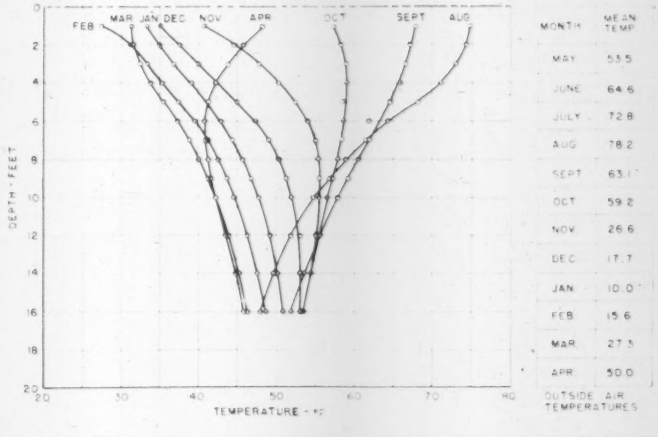

Fig. 4—Monthly variations of ground temperatures 1947-48

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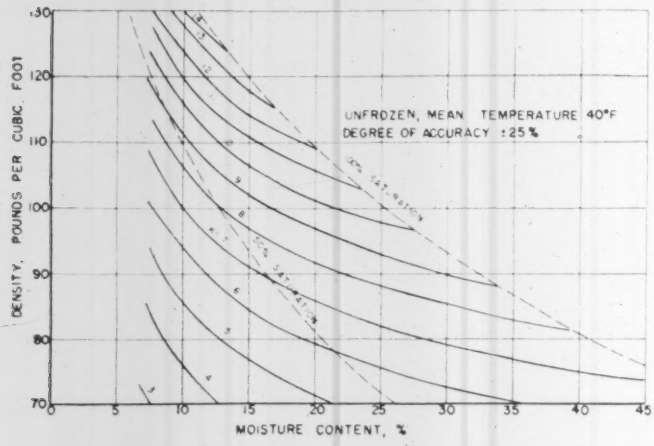

Fig. 6—Diagram of thermal conductivity for silt and clay unfrozen soil (mean temperature of 40 F. Degree of accuracy ± 25 percent)

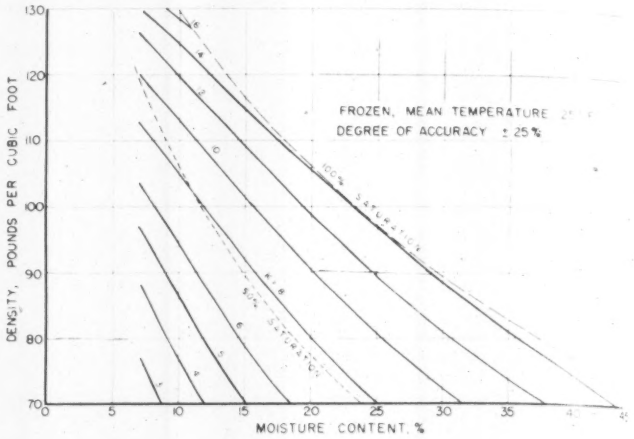

Fig. 7—Diagram of thermal conductivity for silt and clay frozen soil (mean temperature 25 F. Degree of accuracy ± 25 percent)

lower below freezing than above. With an increase in moisture content the conductivity is higher below freezing than above. It is also interesting to note that the conductivity of frozen soil decreases with a decrease in mean temperature.

Figs. 6 and 7 have been included in this paper because they present extensive information on the thermal conductivity of silt and clay soils. The material is part of the results of an investigation to determine the thermal properties of a variety of soils[1]. The work has been performed by the Engineering Experiment Station of the University of Minnestoa for the St. Paul District, Corps of Engineers, U. S. Department of the Army. The curves of Fig. 6 present information on the thermal conductivity of unfrozen silt and clay soils tested at a 40 F mean temperature, while those of Fig. 7 are for frozen silt and clay soils tested at a 25 F mean temperature.

[1]The Thermal Conductivity of Soils, by Miles S. Kersten, University of Minnesota Engineering Experiment Station. (Presented at the Annual Meeting of the Highway Research Board, Washington, D.C., December 1948.)

Conclusions

An analysis of the conductivity test results indicate that the thermal conductivity of the silt and clay soils varies as follows:

1. At a constant moisture content, it increases with an increase in dry density. The rate of increase is fairly constant and is independent of the moisture content.
2. At a constant dry density, it increases with an increase in moisture content.
3. For the unfrozen soil, it increases with an increase in mean temperature.
4. The frozen soil at low moisture content shows very little change; in general, for soils of high moisture content it shows an increase for a decrease in temperature.
5. When changing from unfrozen to frozen soil, the conductivity varies according to the moisture content. For dry soils, it does not change; for soils of low moisture content, it decreases; and with soils of high moisture content, it increases.

Although it was not considered within the scope of this paper to make application to the published mathematical theory underlying heat conduction in the ground, a brief check indicated a close correlation between the calculated results based on test data and the results obtained by mathematical analysis. Additional information on thermal conductivity, density, specific heat, specific gravity and diffusivity of some nineteen different soils is available[2].

Table 3—Results of Conductivity Tests[3]

Test No.	Density lb/cu ft	Moisture Percent	Mean Temperature T	k Btu/sq ft/hr F/in.
1	93.0	1.23	70.3	2.23
2	93.0	1.23	40.1	2.16
3	93.0	1.23	24.9	2.14
4	93.0	1.23	-19.9	2.15
5	92.4	16.70	70.1	9.14
6	92.4	16.70	40.1	8.78
7	92.4	16.70	25.1	11.17
8	92.4	16.70	-19.9	10.97
9	92.4	23.0	70.0	11.00

[3] Tests conducted by Prof. Miles S. Kersten at the Engineering Experiment Station, University of Minnesota.

Acknowledgments

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The author wishes to acknowledge assistance from John V. Borry and Robert D. Turnacliff, graduate students in 1946-1947, and Marvin N. Lee and John R. Jamieson, graduate students in 1947-1948, for taking of test data, analysis of test data and other helpful suggestions. The author is particularly indebted to Prof. Miles S. Kersten, Civil Engineering Department, for laboratory test results and to Prof. Frank B. Rowley, director of the Engineering Experiment Station, for cooperation in making available testing equipment.

[2]Thermal Properties of Soils, Engineering Experiment Station, *Bulletin 28*, University of Minnesota.

Necessity of Using a Directional Mean Radiant Temperature to Describe the Thermal Conditions in Rooms†

By Vagn Korsgaard*, Copenhagen S., Denmark

IN ORDER to describe completely and uniquely the thermal conditions throughout a room, it is necessary to determine not only some kind of a *temperature* at every point but also how this particular kind of *temperature* may vary *in every direction* at each point. It is necessary therefore to consider a *directional temperature* which can best be defined by considering the heat-exchange conditions at a relatively small surface element considered to be located at some point in question within the room space.

The total heat loss given off by the surface element will consist of the heat given off by convection to the air and the net heat loss by radiation to the surrounding surfaces.

The heat lost by convection will depend upon the air temperature and air velocity close to the surface element.

The heat lost by radiation will depend upon some kind of a *mean temperature* of the surrounding surfaces. This particular *mean temperature*, which usually varies when the direction of the surface element is varied, is defined in this paper as the *directional mean radiant temperature* (DMRT) of the room with respect to the surface element[1].

The total heat loss from the surface element can be considered as dependent only upon one particular temperature defined by F. C. Becker[2] and called *the resultant temperature* of the room with respect to the surface element.

The resultant temperature will usually vary with the orientation of the surface element, for it depends upon the DMRT, the air temperature and the air velocity with respect to the surface element.

This paper deals only with the radiation component of the heat exchange, and some equations are given by means of which it is possible to compute the directional mean radiant temperature of a room including the effect of highly reflective surfaces.

A second paper will describe a radiometer to measure the DMRT.

Concept of the DMRT

To visualize the DMRT consider two rooms (see Fig. 1): the one may be an actual room with any temperature distribution on walls, floor and ceiling; the other room is to be a test room in which the entire surface may be kept at any desired uniform temperature. It is further assumed that the air temperature and air velocity at any point in the test room are equal to the air temperature and velocity at the corresponding point in the actual room.

By means of this test room it is possible to find the directional mean radiant temperature of the actual room with respect to any surface element. If, for example, the DMRT of the actual room with respect to the chest of a person standing in a certain position is desired, the procedure is as follows: by means of some ideal heat flow meter the heat loss from the chest of the person is determined, and the person is then moved to the corresponding position in the test room and the uniform temperature of the test room's inside surface is varied until the heat flow meter shows the same heat loss from the chest as in the actual room. The DMRT of the actual room with respect to the chest of the person is then that uniform inside surface temperature of the test room which gives the same heat loss from the chest.

As the air temperature and velocity are the same in both rooms this means that the heat loss by convection from the chest also is the same in both cases and hence the heat loss by radiation must also be the same.

It therefore follows that the DMRT of a room relative to a surface element can be *defined* as that imaginary uniform inside surface temperature of the room for which the net radiant transfer from the surface element to the surrounding surfaces is equal to the net radiant transfer experienced by the surface element in the actual room which has a non-uniformly heated inside surface. A similar conception applied to the body of a person has recently come to the attention of the author[3].

To find the MRT of the room with respect to the body as a whole, it is necessary to determine the DMRT with respect to all parts of the person's surface and take the areal average.

Under comfort conditions the total heat loss from the human body has a certain value, and at a given air

†This and a following paper are based on theoretical and experimental work performed by the author in 1945 at the Heating and Ventilating Research Laboratory of the University of Technology of Copenhagen, Denmark, on a scholarship from the Council of Technical-Scientific Research of Denmark, and written while in residence at ASHVE Research Laboratory March 24—June 25, 1948.

*Fellow of the American-Scandinavian Foundation and mechanical engineer.

[1] Exponent numerals refer to References.

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temperature and velocity the average MRT of the room with respect to the body as a whole must have a certain value in order for the body to obtain this necessary heat-exchange condition for comfort without making use of such things as the sweat glands and shivering.

An example from common experience will show how the assignment of a certain magnitude for the MRT of an entire room is not, in itself, sufficient for specifying comfort conditions. The directional distribution of the radiant heat exchange must be considered.

A person may be standing in front of and facing a hot stove or a hot fireplace and with his back towards a cold window (see Fig. 1). This means that the DMRT with respect to the person's front is very high and with respect to his back very low, and although his areal-averaged MRT still might be correct for obtaining comfort the conditions are not comfortable.

To determine whether comfort conditions are obtained in a room as a whole or in certain places in the room it is necessary not only that the averaged DMRT with respect to the human body be correct but further that the variations in DMRT with respect to the different parts of the body be within a certain range.

From this it will be seen that it is of great importance to be able to compute and measure the DMRT of a room with respect to a surface element.

Defining Relationships for DMRT

A room, as shown in Fig. 2, to be considered has four walls at the uniform Fahrenheit temperature t_w and area A_w square feet, the ceiling at the uniform Fahrenheit temperature t_c and area A_c square feet, the floor at the uniform temperature t_f and area A_f square feet. There are no windows, doors or furniture.

1. All inside surfaces are assumed as thermally black so that no reflection is obtained. The equation which gives the DMRT of the room with respect to a surface element of area A_m and temperature t_m is as follows:

$$(\text{DMRT}) = \frac{h_{rw}\,t_w + h_{rc}\,t_c + h_{rf}\,t_f}{h_{rw} + h_{rc} + h_{rf}} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

when h_{rw} = unit conductance for radiant transfer, Btu per (hr) (sq ft) (F deg), between surface element A_m and walls A_w

$$h_{rw} = \sigma F_{w,m} \frac{T_m^4 - T_w^4}{T_m - T_w} \quad \ldots\ldots (2)$$

and similarly h_{rc} and h_{rf} may be obtained for ceiling and floor areas respectively,

where

σ = Stefan-Boltzmann constant
$F_{w,m}$ = shape factor of walls, A_w, with respect to surface element A_m
T = respective temperature in degrees Fahrenheit, absolute

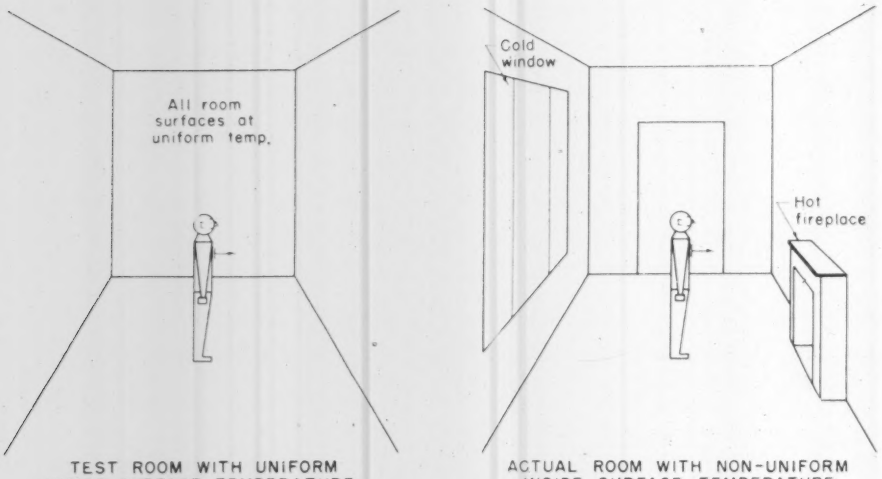
All room surfaces at uniform temp.
Cold window
Hot fireplace
TEST ROOM WITH UNIFORM INSIDE SURFACE TEMPERATURE
ACTUAL ROOM WITH NON-UNIFORM INSIDE SURFACE TEMPERATURE

Fig. 1—Illustration of effect of DMRT

Within the temperature ranges usually prevailing in buildings the factor $\frac{T_m^4 - T_w^4}{T_m - T_w}$ will only vary slightly, so that Equation 1 can be simplified by cancelling this term from both numerator and denominator. Also, the sum of the three shape factors is unity. Then

$$(\text{DMRT}) = F_{w,m}\,t_w + F_{c,m}\,t_c + F_{f,m}\,t_f \quad \ldots\ldots (3)$$

2. Instead of thermally black surfaces let it be assumed that the inside surfaces of the room have any emissivity, which may be more or less reflective but constant over each of the four surfaces. The DMRT can still be computed from Equations 1 and 2 if instead of the actual surface temperatures t_w, t_c and t_f, use is made of fictive temperatures t'_w, t'_c and t'_f given by

$$t'_w = \left(\sqrt[4]{\frac{1}{\sigma} \cdot \frac{\phi_{w,w}}{F_{w,w}} \cdot \frac{H_{r,w}}{A_w}} \right) - 460 \quad \ldots\ldots\ldots\ldots (4)$$

where

$\phi_{w,w}$ = fraction of total radiation from walls, A_w, which strikes the surface element A_w
$F_{w,w}$ = shape factor of surface element A_w with respect to walls, A_w
$H_{r,w}$ = total radiation from walls, A_w, Btu per hour

The equations for t'_c and t'_f are similar. Calculation procedures next will be developed for

$H_{r,w}$ = (energy emitted by walls) + (energy reflected by walls).

Energy emitted by walls, $H_{e,w} = e_w\,\sigma\,T_w^4\,A_w$, Btu per hour.

Energy reflected by walls, $H_{r,w}$ = (fraction of total radiation from ceiling which strikes walls and is reflected) + (fraction of total radiation from floor which strikes walls and is reflected) + (fraction of total radiation from the walls which strikes the walls and is reflected), or, letting the symbol ρ denote respective fractions reflected,

$$H_{r,w} = \rho_{w,c}\,H_{r,c} + \rho_{w,f}\,H_{r,f} + \rho_{w,w}\,H_{r,w}$$

since

$$H_{r,w} = H_{e,w} + H_{r,w},$$

there follows

$$-\rho_{w,f}\,H_{r,f} - \rho_{w,c}\,H_{r,c} + (1 - \rho_{w,w})\,H_{r,w} = H_{e,w} \quad \ldots\ldots\ldots\ldots (5a)$$

By analogous substitutions,

$$(1 - \rho_{f,f})\,H_{r,f} - \rho_{f,c}\,H_{r,c} - \rho_{f,w}\,H_{r,w} = H_{e,f} \quad \ldots\ldots\ldots\ldots (5b)$$

$$-\rho_{c,f}\,H_{r,f} + (1 - \rho_{c,c})\,H_{r,c} - \rho_{c,w}\,H_{r,w} = H_{e,c} \quad \ldots\ldots\ldots\ldots (5c)$$

If $H_{r,w}$, $H_{r,f}$ and $H_{r,c}$ are considered as unknown in the foregoing three linear equations these can be solved.

and using determinant notation it is found that

$$H_{f,w} = \frac{|B_w|}{|A|},\ H_{f,c} = \frac{|B_c|}{|A|} \text{ and } H_{f,f} = \frac{|B_f|}{|A|} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

(I. e.)

$$|A| = \begin{vmatrix} (1-\rho_{f,f}) & -\rho_{f,c} & -\rho_{f,w} \\ -\rho_{c,f} & (1-\rho_{c,c}) & -\rho_{c,w} \\ -\rho_{w,f} & -\rho_{w,c} & (1-\rho_{w,w}) \end{vmatrix}$$

$$|B_f| = \begin{vmatrix} H_{e,f} & -\rho_{f,c} & -\rho_{f,w} \\ H_{e,c} & (1-\rho_{c,c}) & -\rho_{c,w} \\ H_{e,w} & -\rho_{w,c} & (1-\rho_{w,w}) \end{vmatrix}$$

$$|B_c| = \begin{vmatrix} (1-\rho_{f,f}) & H_{e,f} & -\rho_{f,w} \\ -\rho_{c,f} & H_{e,c} & -\rho_{c,w} \\ -\rho_{w,f} & H_{e,w} & (1-\rho_{w,w}) \end{vmatrix}$$

$$|B_w| = \begin{vmatrix} (1-\rho_{f,f}) & -\rho_{f,c} & H_{e,f} \\ -\rho_{c,f} & (1-\rho_{c,c}) & H_{e,c} \\ -\rho_{w,f} & -\rho_{w,c} & H_{e,w} \end{vmatrix}$$

The nomenclature is important. The subscripts are to be interpreted as follows:

$\rho_{w,w}$ = fraction of the total radiation from the walls which strikes the walls and is reflected,

$\rho_{w,f}$ = fraction of the total radiation from the floor which strikes the walls and is reflected, and similarly for $\rho_{w,c}$, $\rho_{f,w}$, etc.

In the general case it is very troublesome or even impossible to find the fractions $\rho_{w,c}$, $\rho_{f,w}$, etc., but in special cases which occur often in practice this can be done relatively simply and with sufficient accuracy.

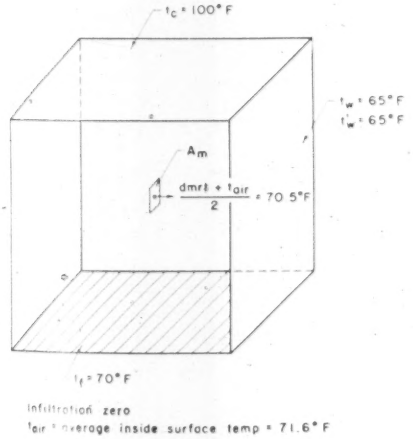

Fig. 2—Room with thermally black floor, ceiling and walls

Instead of using Equations 1, 2 and 4 to find the DMRT (Fahrenheit), it is simpler to use the following equation:

$$(\text{DMRT}) = \sqrt[4]{\frac{1}{\sigma} \cdot \frac{1}{A_m} \cdot \left(\phi_{m,w} H_{f,w} + \phi_{m,f} H_{f,f} + \phi_{m,c} H_{f,c} \right)} - 460 \quad \ldots\ldots\ldots (7)$$

In the foregoing equations it is assumed that the size of the surface element with respect to which the DMRT is evaluated is small compared to the size of the room, so that the influence on the DMRT of the presence of the surface element itself is negligible.

Conclusions

1. The *directional mean radiant temperature* (DMRT) of a room with respect to a surface element, as explained and shown in the equations given, is not a single physical constant for a given room under given thermal conditions, but is a physical quantity that usually varies both with the place and the direction within a room.

2. When running comparative tests on different heating systems—especially when they include such types of heating systems where the thermal conditions in the room are regulated mainly by varying the temperature of larger or smaller parts of the inside surfaces of the room—it is important to pay proper attention to the DMRT as a design factor.

3. In comfort analyses it is important to consider the directional mean radiant temperature as a variable, for at any single point on a person's body the heat transfer conditions represent the combined influences of radiation exchange with those surroundings exposed to that part of the body, of convection, and of evaporation.

Examples

As an example in the use of Equations 3, 4, 6 and 7 the DMRT will be computed for a cubical room with respect to a small surface element placed in the center of the room and set parallel to one of the walls.

Example 1. All inside surfaces of the room (Fig. 2) are considered thermally black, that is, with an emissivity of 1.

The quantities involved in Equation 3 are

Temperature of floor, t_f = 70 F
Temperature of ceiling, t_c = 100 F
Temperature of walls, t_w = 65 F
Shape factors $F_{f,m}$ = 0.1125
$F_{c,m}$ = 0.1125
$F_{w,m}$ = 0.7750

and hence from Equation 3

$$(\text{DMRT}) = 0.1125 \times 70 + 0.1125 \times 100 + 0.775 \times 65 = 69.4 \text{ F}$$

If no infiltration is assumed and if the film coefficient for convection is the same for the floor, the ceiling and the walls, the air temperature will equal the average inside surface temperature. Hence

$$t_{air} = 1/6 \times 100 + 1/6 \times 70 + 4/6 \times 65 = 71.6 \text{ F}$$

If 70 F and an equally weighted average between the air temperature and the MRT are accepted as representing comfort conditions we find

$$\frac{t_{air} + (\text{DMRT})}{2} = 70.5 \text{ F}$$

Example 2. Let only the floor and the ceiling in the cubical room of *Example 1* be thermally black, while the walls are assumed to have an emissivity of 0.06 and to reflect diffusely. (Fig. 3)

The quantities involved in Equation 6 are

Temperature of floor, t_f = 70 F
Temperature of ceiling, t_c = 85 F
Temperature of walls, t_w = 60 F
Emissivity of floor and ceiling = 1 and reflectivity $r_f = r_c = 0$
Emissivity of walls e_w = 0.06 and reflectivity r_w = 0.94

$$\rho_{f,f} = F_{f,f} r_f = 0$$
$$\rho_{c,f} = F_{c,f} r_c = 0$$
$$\rho_{f,c} = F_{f,c} r_f = 0$$
$$\rho_{c,c} = F_{c,c} r_c = 0$$
$$\rho_{f,w} = F_{f,w} r_f = 0$$
$$\rho_{c,w} = F_{c,w} r_c = 0$$

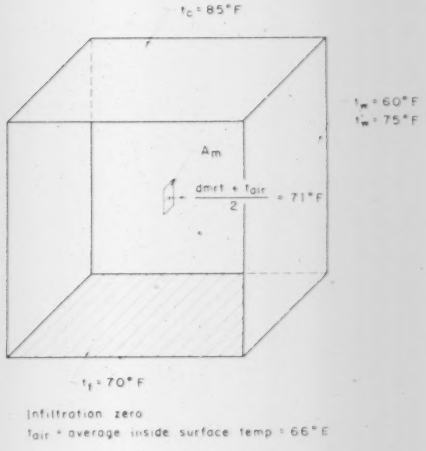

Fig. 3—Room with thermally black floor, ceiling; highly reflective walls

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For the evaluation of $\rho_{w,f}$, $\rho_{w,c}$ and $\rho_{w,w}$ it is assumed for approximate purposes that the radiation to—and hence the irradiation from—the walls is uniform although this is not exactly true, since the upper parts of the walls, due to the higher temperature of the ceiling, will receive more energy than the lower parts. The error introduced by this approximation will probably not be great since the multiple reflection from the highly reflective walls will have a tendency to eliminate this lack of uniformity.

Hence we find

$$\begin{aligned} p_{w,f} &= F_{w,f}\, r_w \\ &= (1 - F_{c,f})\, r_w \\ &= 0.80 \times 0.94 = 0.75 \\ p_{w,c} &= \rho_{w,f} = 0.75 \end{aligned}$$

$$\begin{aligned} p_{w,w} &= F_{w,w}\, r_w \\ &= (1 - F_{f,w} - F_{c,w})\, r_w \\ &= (1 - 2 \times 1/4\, F_{w,f})\, r_w \\ &= 0.69 \times 0.94 = 0.56 \end{aligned}$$

For the determinants, (see Equation 6)

$$|A| = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -\rho_{w,f} & -\rho_{w,c}\,(1-\rho_{w,w}) & \end{vmatrix} = 1 - \rho_{w,w}$$

$$|B_f| = \begin{vmatrix} H_{c,f} & 0 & 0 \\ H_{c,c} & 1 & 0 \\ H_{c,w} & -\rho_{w,c}\,(1-\rho_{w,w}) & \end{vmatrix} = H_{c,f}\,(1 - \rho_{w,w})$$

$$|B_c| = \begin{vmatrix} 1 & H_{c,f} & 0 \\ 0 & H_{c,c} & 0 \\ -\rho_{w,f} & H_{c,w} & (1-\rho_{w,w}) \end{vmatrix} = H_{c,c}\,(1 - \rho_{w,w})$$

$$|B_w| = \begin{vmatrix} 1 & 0 & H_{c,f} \\ 0 & 1 & H_{c,c} \\ -\rho_{w,f} & -\rho_{w,c} & H_{c,w} \end{vmatrix} = H_{c,w} + \rho_{w,f} H_{c,f} + \rho_{w,c} H_{c,c}$$

$$\begin{aligned} T_f &= 70 + 460 = 530 \text{ F abs} \\ T_c &= 85 + 460 = 545 \text{ F abs} \\ T_w &= 60 + 460 = 520 \text{ F abs} \end{aligned}$$

$$H_{c,f} = \sigma T_f^4 = 0.172 \times \left(\frac{530}{100}\right)^4 = 136 \text{ Btu per hour}$$

$$H_{c,c} = \sigma T_c^4 = 0.172 \times \left(\frac{545}{100}\right)^4 = 152 \text{ Btu per hour}$$

$$H_{c,w} = e_w\, \sigma\, T_w^4\ (4) = 0.06 \times 0.172 \times \left(\frac{520}{100}\right)^4 \times 4 = 30 \text{ Btu per hour}$$

$$H_{f,f} = \frac{|B_f|}{|A|} = H_{c,f} = 136 \text{ Btu per hour}$$

$$H_{f,c} = \frac{|B_c|}{|A|} = H_{c,c} = 152 \text{ Btu per hour}$$

$$H_{f,w} = \frac{|B_w|}{|A|} = \frac{H_{c,w} + \rho_{w,f} H_{c,f} + \rho_{w,c} H_{c,c}}{1 - \rho_{w,w}} = \frac{30 + 0.75 \times 136 + 0.75 \times 152}{1 - 0.56} = 560 \text{ Btu per hour}$$

The same approximation as made in the foregoing when evaluating $\rho_{w,f}$, $\rho_{w,c}$ and $\rho_{w,w}$ is made when evaluating $\phi_{m,w}$; hence

$$\phi_{m,w} = F_{m,w} = \frac{A_m}{4} F_{w,m} = \frac{A_m}{4}(0.775) = A_m\,(0.194)$$

as the floor and ceiling are thermally black.

$$\phi_{m,f} = F_{m,f} = \frac{A_m}{1} F_{f,m} = A_m\,(0.1125)$$

$$\phi_{m,c} = F_{m,c} = F_{m,f} = A_m\,(0.1125)$$

By substituting these values in Equation 7,

$$(\text{DMRT}) = 100 \sqrt[4]{\frac{1}{0.172} \cdot \frac{1}{A_m} \cdot A_m\,(0.1125 \times 136 + 0.1125 \times 152 + 0.194 \times 560)} - 460$$

$$= 100 \sqrt[4]{\frac{1}{0.172} \times 141.4} - 460 = 100 \sqrt[4]{823} - 460 = 536 - 460 = 76 \text{ F}$$

If we assume, as was done in *Example 1*, that there is no infiltration and that the film coefficient for convection is the same for the floor, the ceiling and the walls, the air temperature will equal the average inside surface temperature. *Hence*,

$$t_{air} = 1/6 \times 70 + 1/6 \times 85 + 4/6 \times 60 = 66 \text{ F}$$

and

$$\frac{t_{air} + (\text{DMRT})}{2} = \frac{76 + 66}{2} = 71 \text{ F}$$

which equals the corresponding temperature in *Example 1* within 0.5 deg.

By substituting in Equation 4 the fictive wall temperature is found to be

$$t'_w = 100 \sqrt[4]{\frac{1}{0.172} \cdot \frac{\phi_{m,w}}{F_{m,w}} \cdot \frac{560}{4}} - 460$$

$$= 100 \sqrt[4]{\frac{1}{0.172} \times 1 \times 140} - 460$$

$$= 100 \sqrt[4]{315 - 460} = 535 - 460 = 75 \text{ F}$$

and by means of Equation 3

$$(\text{DMRT}) = 0.1125 \times 70 + 0.1125 \times 85 + 0.775 \times 75 = 75.5 \text{ F}$$

which agrees within 0.5 deg with the DMRT found by using Equation 7.

Conclusions which can be drawn by comparison of *Examples 1* and *2* are:

1. In a panel-heated room it is possible to keep the temperature of the panel considerably lower than otherwise—and still obtain the same value for $\frac{t_{air} + (\text{DMRT})}{2}$—when parts of the inside surfaces are made highly reflective. How much the temperature of the panel can be lowered depends mainly on: (*a*) Location and size of the panel; (*b*) Reflectivity, size and location of reflective surfaces; (*c*) Geometric form of the room.

2. The lower average inside surface temperature of the room when parts of the inside surfaces are highly reflective results in a lower air temperature dependent on the infiltration rate. The lower inside surface temperature is due partly to the lower panel temperature and partly to the fact that an increase of the reflectivity of the inside surface of a wall results in a decrease of the surface temperature, under equal conditions.

3. The heat loss from the room for the same value of $\frac{t_{air} + (\text{DMRT})}{2}$ is less when parts of the inside surfaces are highly reflective, partly because the air temperature is lower and partly due to the fact that a higher reflectivity of parts of the inside surfaces produces a greater thermal resistance for these parts, and hence a lower heat flow.

4. The values given in these examples are based on an infiltration of zero, but the importance of the lower room air temperature in lessening the heating load will increase with increasing infiltration rate.

References

1. Undersoegelser over det termiske Straalingsfelt i Rum med reflekterende Vaegge, by Vagn Korsgaard. (Meddelelse XII fra Danmarks tekniske Hoejskoles Laboratorium for Opvarmning og Ventilation.)

2. On Thermal and Calorific Fields in Buildings, by F. C. Becker. (*Transactions, Danish Academy of Technical Sciences*, No. 4, 1947—in English).

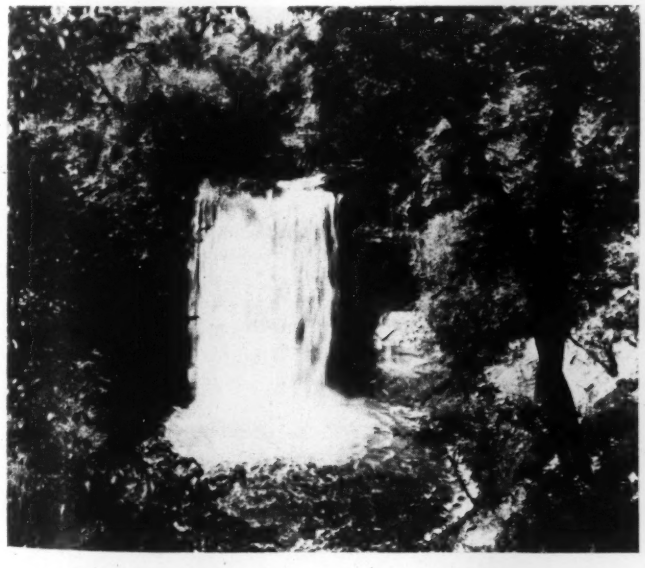
3. Panel Heating and Cooling Analysis, by B. F. Raber and F. W. Hutchinson (John Wiley and Sons, 1947, p. 69).

Campus of the University of Minnesota from the air, with Mississippi River in the foreground

Semi-Annual Meeting Under Minnesota Skies

June 20-22, 1949

The summer get-together for technical sessions . . . discussion of 10 papers . . . heat pump, solar energy, air flow, ground temperatures, tolerance to extreme heat, cooling loads, water vapor transmission, blower performance . . . tours and golf tournaments . . . meeting friends from afar . . . will you be there?



Minnehaha Falls in Minnehaha Park

Hotel Nicollet—Semi-Annual Meeting Headquarters

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HOW TO ATTEND A SOCIETY MEETING

Regarding a recent meeting of the *AIME*, E. H. Rose of the Tennessee Coal, Iron and Railroad Co. wrote an article telling engineers how to attend annual meetings so as to derive the greatest benefit from them. The article, published in the *AIME* Journals, is partly repeated here:

(1) *Information picked up in person-to-person contacts bulks far larger in take-home payoff than the official fare.* Active part in a technical session is taken by the engineer only in discussion from the floor, but after the session is over, engineers have a chance to meet in the corridors and in the informality of private rooms. There, personal experiences can be exchanged, and small, but important problems can be discussed.

(2) *Repeated attendance pays increasing dividends:* "Implicit in the foregoing is acquaintance with those persons of the most relevant interests, and the degree of mutual benefit is measurable by the degree of mutual friendship, understanding and respect. The standoffishness of strangers is fatal; the camaraderie of old friends, perhaps not seen since the preceding meeting, is the instantaneous catalyst that induces the real reaction of minds, and the real yield of profitable guidance on both sides."

(3) *Reciprocity is essential:* The article states that merely sending in annual dues and accepting merchandise of said value gains few results. "Many inactive members sincerely believe that they are not qualified to write papers, for lack of either material or talent. Often, that may, indeed, be true, but it does not follow that they are unqualified to pursue other activities, such as serving on national or local section committees, all of which is as voluntary as the writing of papers and even more rewarding.

Someone may say that he has never been put on a committee. The process is not quite so passive; one has first to open his eyes to the many ways in which he could be useful to others and thus in due process to himself and to his employer. To be selected, he must become visible. A few thoughtful letters, written to the chairmen of committees covering his field of work or his geographic area, making suggestions, offering criticisms, or even merely asking the questions he asks himself verbally will soon put the member on the main line moving with traffic."

And so, the question *how to attend an annual engineering meeting* boils down to one simple principle: "Give and ye shall receive."

1949 ESSAY CONTEST

Because of the many fundamental problems involving reactions of human beings to their environment, the ASHVE has pioneered in basic inquiry and investigation in this field and its findings have been recorded in the Society's TRANSACTIONS.

In order to stimulate greater interest among the younger members of ASHVE in these studies, the Advisory Board, composed of ASHVE past presidents, is sponsor for a series of essay competitions and for 1949 the following conditions have been established:

1. The 1949 award shall be called the **Marcia Garrick Fleisher Award**, in memory of the wife of Walter L. Fleisher, a past president of the Society and donor of the first award of $100.00 to be given for the best essay submitted in accordance with the rules which follow.
2. Subject of the essay may be any one of several topics:
   a. An original idea leading to some new knowledge of air conditioning in relation to human comfort.
   b. An original idea in connection with the thermodynamics of air.
   c. The question of the sensory effect of the moisture content of air in contact with the human body.
   d. An original physiological or psychological approach to the development of a research project which would investigate human reactions to the atmospheric environment.

Who Is Eligible

All Junior and Student members of ASHVE as of August 1, 1949, except paid employees of the Society, are eligible.

Rules of the Competition

1. All manuscripts to be in the hands of the judges on or before September 1, 1949.
2. Length of the essay should not exceed 3000 words.
3. Use of photographs, drawings, charts, or tables, is optional.
4. Manuscripts should be typewritten, double-spaced on one side of 8½ in. x 11 in. sheets.
5. The first page should contain only the *title of the essay*, and the *author's name and address*. On the second page, the title should be repeated and the essay begun halfway down the page. The *author's name and address should not appear on the second page.*
6. The essay should be forwarded to: Secretary, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, 51 Madison Avenue, New York 10, N. Y.
7. A board of three judges will select the winning essay. These judges will be selected—*one* by the Chairman of the Advisory Board, *one* by the President of the Society, and *one* by the Chairman of the Publication Committee.
8. The judges will receive all manuscripts by September 10, 1949, and will render their decision by October 15, 1949.
9. The winning essay will be considered for presentation at the 56th Annual Meeting in January 1950. Other meritorious essays will be considered by the Publication Committee for JOURNAL publication.
10. Decision of the judges shall be final.

PERSONALS

John Everetts, Jr. is now associated with Charles S. Leopold, consulting engineer, Philadelphia, Pa. Mr. Everetts, a member of ASHVE since 1929, was formerly a partner in the firm of Urdahl & Everetts, consulting engineers, Washington, D. C.

E. N. Kemler has been appointed director of the Southwest Research Institute, Houston, Tex. Previously, he was on the staff of the College of Engineering, New York University, New York City. Mr. Kemler joined the ASHVE in 1946.

Orion O. Oaks, a past president of New York Chapter, has announced the formation of the firm of Orion O. Oaks Associates, consulting engineers, Somerville, N. J. Mr. Oaks was formerly director of research at the John B. Pierce Foundation, Raritan, N. J. He has been a member of ASHVE since 1917.

Joe Wheeler, Jr. has been appointed manager of the New York branch of the Johnson Service Co., Milwaukee. Mr. Wheeler has been with the Johnson Service Co. since 1931 and came to the New York office in 1935. He is a past president of the New York Chapter of the Society.

E. J. Hoaglund now heads a new branch office of the Johnson Service Co., Milwaukee. Formerly sales engineer in the company's Boston office, Mr. Hoaglund is in charge of installations in most of Connecticut and Vermont and in western Massachusetts.

L. E. Seeley

SEELEY REPRESENTS ASHVE ON NATIONAL RESEARCH COUNCIL

L. E. Seeley, 2nd vice president of the Society and dean of the College of Technology, University of New Hampshire, Durham, N. H., is ASHVE representative on the *National Research Council*, which is conducting research in a number of fields.

Meetings during the past months of 1949 have included conferences on building construction, military clothing, ship building, and scientific terminology. Twenty societies, among them the ASHVE, comprise the NRC's Division of Engineering and Industrial Research.

ASHVE MEMBERS TAKE PART IN AIR POLLUTION MEETINGS

Five ASHVE members participated as authors or speakers at the recent meetings of the *American Chemical Society* in San Francisco, dealing with problems of atmospheric pollution and purification.

Members R. L. Lincoln, Dover, Mass., and F. E. Cooper, San Francisco, were authors of the paper, *Electrostatic Precipitation of Atmospheric Air*. Presented by F. W. Jordan, San Francisco member, the paper described the basic principles, development, design, operation and application of current electrostatic apparatus.

A paper on exhaust ventilation for solid materials handling was presented by member R. H. Walpole, Jr., of San Francisco. Co-authored by R. T. Pring, J. F. Knudsen, and Richard Dennis, Garfield, Utah, the paper discussed the calculation of exhaust capacities, and gave details for reducing the amount of solids carried into the ventilating system.

ASHVE Guide Publication Committee Meeting at Society's Research Laboratory, Cleveland, April 29, 1949

(L. to R.) **Clifford Strock, New York, R. P. Cook, Rochester, Minn., P. B. Gordon, New York, Cyril Tasker, Cleveland, A. V. Hutchinson, New York, W. N. Witheridge, chairman of committee, Detroit, C. H. Flink, New York, H. R. Limbacher, Kalamazoo, Mich., Nathaniel Glickman, Chicago, P. J. Marschall, Chicago, and E. F. Hyde, Detroit**

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C. C. Wright, ASHVE member from State College, Pa., was a co-author of a paper describing the use and limitations of the midget impinger method of collecting and analyzing dust-laden air by means of a sampling instrument and technique.

Messrs. Cooper, Jordan, and Walpole belong to the Golden Gate Chapter of the Society.

CLEVELAND SOCIETIES ELECT WILHELM

Joseph E. Wilhelm, vice president of Avery Engineering Co., Cleveland, has recently been elected president of the *Cleveland Technical Societies Council*, a group representing 40 engineering and scientific organizations in the Cleveland area.

J. E. Wilhelm

A graduate of Case Institute of Technology, Mr. Wilhelm was with the Minneapolis-Honeywell Regulator Co., Minneapolis, before becoming associated with Avery Engineering Co. He has belonged to the ASHVE since 1934 and served as president of the Northern Ohio Chapter in 1946-47. During the Society's Annual Meeting in Cleveland in January 1947, he served as chairman of the Reception Committee.

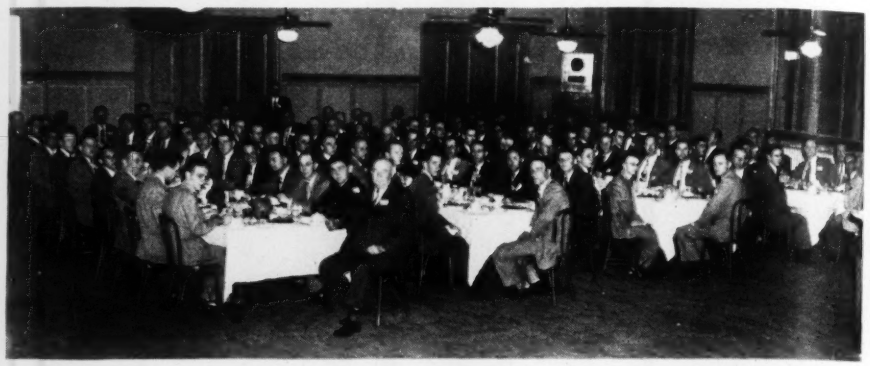
He is also a member of the *ASRE*, and was chairman of its Cleveland Section in 1943-44.

KANSAS U. STAGES ENGINEERING EXPOSITION

The recently organized ASHVE Student Branch of the University of Kansas took part in the annual Engineering Exposition held at Lawrence, Kansas, on April 22 and 23. The student branch had a booth with displays of the Society's activities and purposes as well as exhibits of heating and air conditioning equipment.

Representing the faculty at the show was Prof. H. L. Daasch, head of the mechanical engineering dept. and adviser to the ASHVE student branch whose president is Vance Elder (for story of University of Kansas Student Branch organization see ASHVE JOURNAL SECTION May 1949, p. 141).

AIR CONDITIONING CONFERENCE BANQUET IN TEXAS



General view of Conference Banquet—B. P. Fisher at microphone

GIESECKE HONORED AT TEXAS CONFERENCE

Dr. F. E. Giesecke, a speaker at the 5th Annual Air Conditioning Conference, Houston, Tex., was honored by the presentation of a scroll by the South Texas Section of *ASME*.

Presentation was made by Prof. J. G. Thompson, chairman of the Section. The scroll described some of Dr. Giesecke's achievements as author, consulting engineer and research engineer. (See ASHVE JOURNAL SECTION May 1949, p.136, for Conference story.)

Banquet speaker J. R. Hertzler *(left)* and Toastmaster C. W. Crawford

(L. to R.) W. E. FitzGerald, Prof. W. E. Long, C. P. Howard, J. R. Hertzler, C. W. Crawford, B. P. Fisher, Marvin Brown and D. M. Mills

Summary of Local Chapter Meetings

MASSACHUSETTS CHAPTER HEARS DR. TELKES ON SOLAR HEATING

R. T. Kern, president, Massachusetts Chapter, calling March meeting to order

The use of chemicals to trap and store solar energy was described by Dr. Maria Telkes, who spoke before 127 members and guests of the Massachusetts Chapter of ASHVE gathered on March 22 at the Massachusetts Institute of Technology, Cambridge.

Dr. Telkes, a research associate in the metallurgy department of the Institute, pointed out that the direct use of solar energy was not a new development, having been adopted by the Romans for their greenhouses.

Over a period of years, Dr. Telkes has been interested in the utilization of solar energy. Results of her interest and research have been put to use since Christmas Eve 1948 in a "solar house" which is heated only by solar energy.

The method involves use of Glauber's salt as a heat storage medium. Air from the collector heated by the rays of the sun is blown over cans containing the salt. As the salt absorbs the heat, it liquefies. When heat is required in the living area, fans blow the cool air from the rooms into the storage bins. The cool air picks up heat as the salt solution recrystallizes. This cycle occurs at about 90 F which provides air warm enough to heat the house.

The Blue Hills Observatory of the weather bureau has cooperated with Dr. Telkes in supplying data from solar energy measurements. A system of recording instruments has been installed in the solar house.

Dr. Telkes emphasized that the maximum hourly heat loss is not used in calculating the heating demands of the solar house. It is the average heat loss for periods as long as a month which must be considered, she said.

Following Dr. Telkes' talk, George V. Parmelee, Research Associate, ASHVE Research Laboratory, Cleveland, discussed some phases of solar heat transmission. Several members of the audience contributed to the discussion period.

On the afternoon of the meeting, 50 members and guests of the Massachusetts Chapter journeyed to Dover, Mass., to inspect the solar house. During their visit, a cousin of Dr. Telkes, Dr. Nemethy, who lives in the solar house with his family, pointed out the principal features of the heating system.

Dr. Maria Telkes, research associate in Metallurgy Dept., MIT, Cambridge

Massachusetts Chapter members

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JOURNAL SECTION

Charter Meeting of the University of Kansas Student Branch

Kansas City Chapter Officers and Guest Speaker

(L. to R.) Henry Gould, president; C. W. Schumacher, chairman of membership committee; K. M. Stevens, secretary; Speaker Carl E. Boester, member of ASHVE Council; W. E. Howarth, treasurer; Henry Nottberg, vice president.

D. M. Allen presents Charter to Student Branch Officers

(L. to R.) L. H. Noll, secretary-treasurer; James Williams, vice president; V. H. Elder, president; D. M. Allen, member of ASHVE Council and past president of Kansas City Chapter; Prof. H. L. Daasch, head, University M. E. Dept.

• ATLANTA—March 4, 1949. Guest speaker at the regular monthly meeting was Charles Segal of the Kramer Trenton Co., Trenton, N. J. Mr. Segal gave a discussion and demonstration of small capacity evaporative condensers and defrosting apparatus.

The meeting was preceded by a dinner, after which Chapter business was conducted. Nash Lowe reported for treasurer F. W. Bull, and S. W. Boyd spoke on *The Atlanta Building Code*. Pres. Leo Sudderth presided. Attendance 41.

• CENTRAL NEW YORK—April 20, 1949. Newly elected officers of the Chapter were announced at the meeting in Syracuse, as follows: *President*—V. S. Day; *Vice President*—A. L. Jones; *Secretary*—J. H. Carpenter; *Treasurer*—F. E. Krell. The new *Board of Governors* is composed of D. L. Mills, P. R. Robson and R. L. Manier.

A panel discussion on *Warm Air Heating* was led by W. L. Riehl who reviewed the functions of a warm air heating system and sketched out several arrangements as applied to multi-room structures. Discussions of design features and application of various warm air heating equipment were given by H. Aronson and H. F. Randolph. After the talk, questions were asked by members of the audience.

Among the business conducted was a review of the Chapter's activities during the past year given by H. G. Strong, chairman of the Board of Governors. Attendance 34. Attendance ratio 0.35.*

• CENTRAL OHIO—March 21, 1949. Close control of humidity and temperature of the All Weather Room at Wright Field was a point stressed by L. R. Craig, speaking at the meeting in Columbus. Mr. Craig, who is with York Corp., York, Pa., described problems encountered in the operation of the airport's experimental room, including the subject of insulation and vapor barriers.

The smoke inspection program of the city was discussed by R. S. Curl and D. R. Black. Mr. Curl also gave the treasurer's report. Attendance 44.

• CINCINNATI — March 1, 1949. *Multiple Management* was the subject of the talk given by W. L. McGrath, president of the Williamson Heater Co. and the Cincinnati Chamber of Commerce. Mr. McGrath spoke about labor relations and management, and a discussion period followed.

Reports were given by C. D. Weaver, Jr., H. E. Russell, A. H. Gerdsen, and T. D. Reiley. It was announced that the next meeting would feature a talk on the costs and problems of the heat pump. The guest speaker was introduced by F. B. DeBra. Attendance 78. Attendance ratio 0.82.

• DELTA—April 12, 1949. Chapter delegates' activities at the 55th Annual Meeting were discussed by J. S. Burke before Delta members and guests in New Orleans. A number of business matters was conducted, including instructions about sponsorship for applicants.

Pres. L. V. Busenlener read a letter from the Nominating Committee of the Society. The subject of a monthly Chapter news bulletin was taken up, as well as an early summer social meeting.

A joint meeting with *ASRE* was voted by the Chapter for July 21, as a social gathering. Two movies on

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

hunting and fishing were presented. Attendance 19. Attendance ratio 0.27.

• GOLDEN GATE—April 7, 1949. The Chapter had many *ASME*, *AIA* and *AIEE* guests at the meeting in San Francisco. The speaker of the evening was F. W. Jordan of ASHVE and district manager, Westinghouse Electric Corp., Sturtevant Div., who spoke on the heat pump and also answered questions from the audience.

Codes including the radiant heating code were discussed by C. H. Bazille, J. E. Murray, and F. L. Nemec. Charles Pope of *AIA* also participated.

Pres. H. V. Hickman called for reports from Eric Roberts, reception committee, and Karl Baldwin, program chairman. It was announced that the May meeting, the last until fall, would feature a talk on *Glycol Vaporization for Sterilizers*. Attendance 103.

• ILLINOIS—April 11, 1949. Nearly 61 million gallons of water are needed daily in Chicago for air conditioning purposes, L. D. Gayton, of the City's Bureau of Engineering, told Chapter members at the meeting in Chicago. His talk was followed by a discussion of evaporative condensers and cooling towers, by S. I. Rottmayer, of Samuel R. Lewis and Associates, Chicago.

Mr. Gayton stated that since 1941, when Chicago had 20,000 tons installed, air conditioning equipment has now increased to 80,000 tons, and limited sewer capacity has revealed a need for water conservation.

A means of conserving the water supply was then pointed out by Mr. Rottmayer in his talk on condensers and cooling towers. He described the various types of condensers and cooling towers, giving details of construction and design. He also explained the formulas used in determining efficiency and the selection of the proper equipment. Attendance 112.

• INDIANA—March 25, 1949. Fan selection and sound control were the subjects of the talk given by Thomas Walters before the Chapter meeting in Indianapolis. Mr. Walters, Research Director of American Blower Corp., Detroit, stressed the importance of his subject as a result of the high static pressures necessary in fan systems as they are now designed. He illustrated his talk with slides.

A brief talk was made by ASHVE Secy. A. V. Hutchinson who was passing through town. Mr.

N. W. Downes

Hutchinson spoke about the summer meeting of the Society.

A report on the Board of Governors meeting was given by C. F. A. Locke, Chapter secretary. Introductions of guests and speakers were made by Pres. P. R. Jordan and G. B. Supple. C. H. Hagedon, program chairman, announced the speaker for the next meeting. Attendance 71.

• IOWA—April 12, 1949. Applications of panel heating to farm buildings was one of the interesting features of Prof. A. B. Algren's talk to the Chapter in Des Moines. Prof. Algren defined heating as *maintaining space at a temperature comfortable in which to live;* panel heating was described as *a method of maintaining an environment.*

The data based on warm air panel heating were also applicable to hot water panel heating panels, Professor Algren said. He showed slides of floor plans in several buildings. He stressed the need for proper insulation below the heating panel.

D. E. Schroeder spoke about the engineering program at Iowa State College at Ames. Vice Pres. D. E. Wells spoke briefly on the next month's program, tentatively set as a tour through the new Drake University buildings.

Pres. D. C. Murphy invited members to a mid summer meeting at his home. The invitation was accepted, with the date to be set later. Attendance 32.

• KANSAS CITY—April 4, 1949. Nate W. Downes, leaving for California, was honored by Chapter members who presented him with a past president's emblem. J. M. Arthur, Jr. spoke to the group regarding Mr. Downes' service to the Society and community. Mr. Downes is a former member of the ASHVE Council and will be supervising engineer for the state of California (see ASHVE JOURNAL SECTION, May 1949, p. 116).

Methods of cooling a multi-story office building were described by E. G. Rapp, of the General Electric Co., Dallas, Tex. He explained the operation of an individually controlled water cooling system.

A talk on *Labor Management Relations* was given by John Jenner, of the Shelley Electric Co., Wichita, Kans. Reports were made as follows: D. M. Allen, nominating committee, C. W. Schumacher, student branch, C. D. Jones, entertainment, and W. E. Howarth, Chapter finance. Attendance 57.

• MANITOBA—April 21, 1949. The following were elected as officers for 1949-50 at the meeting in Winnipeg: *President*—A. W. Moss; *Vice President*—D. F. Michie; *Secretary-Treasurer*—C. M. Fleming. *Board of Governors:* J. A. Bell, J. F. Bertram, A. K. Piercy, E. H. Price, and J. R. Stephenson.

Engineering Air Distribution was the subject of a paper presented by V. M. Lathers, Rockford, Ill. Details of the Chapter's annual meeting in May were discussed and a committee on arrangements was appointed consisting of Einar Anderson, chairman, C. M. Fleming and D. G. Saunders. A letter from the Minne-

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sota Chapter regarding the Semi-Annual Meeting was read. Attendance 40.

• **MEMPHIS**—April 18, 1949. At the regular meeting of Memphis Chapter held at the King Cotton Hotel, Memphis, the following officers were elected to serve for 1949-50: *President*—Walker L. Wellford, Jr.; *Vice President*—Carl S. Fischer; *Secretary*—Alex T. Bevil; *Treasurer*—Roy W. Johnson.

• **MEMPHIS**—March 21, 1949. Ernest Szekely, ASHVE treasurer and president of Bayley Blower Co., Milwaukee, Wis., spoke before the Chapter on *Design and Selection of Fans.*

Chapter Delegate C. S. Fischer gave a report on the 55th Annual Meeting at Chicago. Attendance 28.

• **MICHIGAN**—April 11, 1949. Twelve members gave a variety of short talks at the meeting in Detroit, as follows: N. B. Elliott, air washers; G. H. Tuttle, absorption system of air conditioning; J. T. Reader, vacuum heating systems; W. C. Randall, natural ventilation; E. E. Dubry, city code for operating pressure vessels; R. F. Connell, business prospects for manufacturing; C. D. Mericle, sales trends in air conditioning; J. H. Spitzley, ventilating of a college chemistry building; G. W. Akers, ASHVE research facilities; Prof. Axel Marin, possibility of student branch at University of Michigan; H. E. Ziel, sound control and decibels; C. F. Mally, radium activity tracers.

Lester T. Avery
Cleveland, Ohio

Ernest Szekely
Milwaukee, Wis.

H. P. Dolan, who was in charge of the forum of speakers, acted as chairman. A report on the chapter delegates meeting at Chicago was given by Pres. E. F. Hyde. L. A. Esslinger reported on memberships, and C. F. Donohoe gave the treasurer's report. Attendance 72.

• **MICHIGAN**—March 14, 1949. A record attendance of 210 members and guests at Detroit heard several speakers, who included: Lester T. Avery, first vice president of ASHVE; Professor Uicker of the University of Detroit; and John W. Norris, vice president of the Lennox Furnace Co., Marshalltown, Ia.

Mr. Norris spoke on *Comparing Circulating Warm Air Heating With Radiant Heating.* Mr. Avery presented a charter to the University of Detroit student branch (see ASHVE JOURNAL SECTION, May 1949, p. 142).

• **MINNESOTA**—April 20, 1949. Hospitality is to be the watchword of the Minnesota Chapter for the Semi-Annual Meeting of ASHVE, J. E. Haines told members in Minneapolis. He outlined the plans being carried out by the committees for this meeting.

A panel discussion on *Heating & Ventilation Codes* was conducted by moderator A. B. Algren and speakers M. S. Wunderlich, Minneapolis, and J. J. Aeberly, Chicago. After the formal talks, questions were asked by the audience.

L. J. Krause announced the program for May. Pres. O. L. Lilja spoke briefly about smoke abatement laws, and F. B. Rowley reported for the nominating committee. H. E. Palmer, President of the Minnesota Federation of Engineering Societies, spoke about this organization and its activities.

Before the business meeting, dinner was served. Entertainment by a musical trio was provided, and group singing was conducted briefly. Attendance 118.

• **NEBRASKA**—April 19, 1949. *Warm Air vs. Radiant Heating* was the subject of the talk given before the chapter in Omaha by Roger W. Booth, Marshalltown, Iowa. Mr. Booth, general sales manager of Lennox Furnace Co., also discussed the importance of continuous blower and pump operation as well as short cycling controls. In the question and answer period that followed, it was concluded that either radiant heating or warm air would be satisfactory if properly engineered and designed.

Pres. K. R. Magarrell presided over the meeting which was preceded by a dinner. Attendance 46.

• **NEW YORK**—April 18, 1949. A highlight of the evening was the presentation of a plaque to Prof. M. C. Giannini, in recognition of his services as Chapter president 1947-8. The presentation was made by W. H. Driscoll on behalf of the Chapter.

Pres. A. A. Bearman stated that Walter Tusch, newly elected Life Member of the Society, had been invited to be the guest of the Chapter but that he was unable to attend.

Factors Affecting Cooling Tower Design was the subject of a talk by N. P. Green, president, Water Cooling Equipment Co., St. Louis, Mo. Mr. Green used charts to show the various factors. He showed how designs could be made to suit conditions of air and water temperature.

The following officers were elected for 1949-50: *President*—Helge S. Johnson; *Vice President*—Carl F. Kayan; *Treasurer*—W. M. Heebner; *Secretary*—Carl H. Flink.

• **NORTH TEXAS**—April 18, 1949. At the April meeting in Dallas the architect's relation to the heating and air conditioning engineer was pointed out by Grayson Gill. Mr. Gill, who is an architect, spoke about the purposes of specifications and the various ways architects and engineers can interpret them.

Reports were made by A. W. Stubbeman, C. R. Gardner, and Pres. G. A. Linskie. Attendance 90. Attendance ratio 0.53.

• **NORTH TEXAS**—March 21, 1949. A sound film and a talk on refrigeration in air conditioning were features of the meeting in Dallas. The speaker was W. S. Bodinus, district manager, Carrier Corp., Chicago., introduced by F. L. Gray, Jr.

C. R. Gardner gave a report on the progress of plans for the 1950 Annual Meeting and also described the Air Conditioning Conference at A. & M. College. Brief reports were given by the following committtees: program, membership, and attendance. M. J. Murray reported on the student branch meeting in Austin, March 11. Attendance 109. Attendance ratio 0.58.

• **NORTHEASTERN OKLAHOMA**—April 5, 1949. Chapter member T. S. Reagan, was guest speaker for the April meeting in Tulsa. Mr. Reagan of the Webster Engineering Co., spoke on *The Application of Gas Burners to Various Types of Boilers.*

Pres. W. R. Lee read a letter from the Minneapolis Chapter inviting members to attend the Semi-Annual Meeting. President Lee also reported on activities of ASHVE Council in Chicago.

A. E. Stacey, Jr., society president, was announced as the speaker for the May 5 meeting.

After some discussion, members voted to continue chapter meetings throughout the summer. The nature of future meetings was also discussed. Attendance 25.

• **NORTHEASTERN OKLAHOMA**—March 15, 1949. The heat pump was the subject of a talk given by A. C. Menke at the Chapter meeting in Tulsa. Mr. Menke, of The Trane Co., La Crosse, Wis., used specific examples to illustrate his talk. A question and answer period followed.

Pres. W. R. Lee read a report on national building codes as compiled by the Bureau of Standards. Attendance 28.

• **NORTHERN OHIO**—April 11, 1949. The application of automatic control to heating and air conditioning was described by J. R. Vernon, who was guest speaker at the meeting in Cleveland. Mr. Vernon, of the Johnson Service Co., Milwaukee, Wis., developed the various steps in control and also spoke of the use of controls in radiant heating.

R. L. Byers reported on the Chapter Delegates meeting in Chicago. R. E. Leising reported for the membership committee. A letter from the Minnesota Chapter inviting all to attend the summer meeting of ASHVE was read. Attendance 83.

• **OKLAHOMA**—April 11, 1949. Speaker at the April meeting in Oklahoma City was M. B. Baker of International Business Machines Corp., who discussed and demonstrated an indicating and signalling system. Ten students from Oklahoma A. & M. College were guests at the meeting. Attendance 35.

• **ONTARIO**—April 12, 1949. J. E. Haines, vice president of Minneapolis-Honeywell Regulator Co., Minneapolis, spoke on *Electronic Controls in Air Conditioning*, with reference to railroad cars. Mr. Haines outlined the progress made in the heating and air conditioning of passenger cars and described methods in current use.

J. E. Haines
Minneapolis, Minn.

Vice Pres. H. H. Strain, who presided over the meeting, also announced the program for the May meeting. W. H. Evans presented the principal speaker. Attendance 84. Attendance ratio 0.38.

• **OREGON**—March 25, 1949. The annual banquet was held in Corvallis as a part of the Oregon State 6th Air Conditioning Conference, at which A. E. Stacey, Jr., ASHVE president, spoke. The banquet room was also the scene of the installation of the 1949-50 officers of the Oregon Chapter. The newly organized student branch of Oregon State College was given its charter by Pres. Stacey.

Other speakers were Dean G. W. Gleeson of Oregon State College and Ben Hazen, president of a Portland bank. Mr. Hazen spoke on *The American Way in Business—Free Enterprise.*

(For further details and pictures of the Oregon State College Conference, see ASHVE JOURNAL SECTION, May 1949, pp. 139, 141).

• **PACIFIC NORTHWEST**—April 12, 1949. At the April meeting at Seattle, the following were elected for 1949-50: *President*—J. D. Sparks; *Vice President*—C. A. Pangborn; *Secretary*—Bert Pride; *Treasurer*—R. R. Kirkwood

Guest speaker was R. H. Walpole, Jr., of the American Air Filter Co., Pacific Coast branch. Mr. Walpole spoke on *Atmospheric Pollution of Cities*, outlining methods used to combat the smoke problem.

Pres. L. L. Bysom reported on his activities at the 55th Annual Meeting in Chicago last January. R. H. Liniger reported on the exhibits at the Exposition. Attendance 40.

• **PHILADELPHIA**—April 14, 1949. The following officers were elected

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for the coming year: *President*—F. H. Buzzard; *1st Vice President*—J. W. McElgin; *2nd Vice President*—Earl K. Wagner; *Secretary*—C. F. Dietz; *Treasurer*—M. E. Barnard, and *Board of Governors*—L. M. Church.

The speaker of the evening, George V. Parmelee, Research Fellow, ASHVE Laboratory at Cleveland, gave a talk on *Solar Radiation and Its Importance to the Air Conditioning Engineer*. J. O. Kirkbride presided. Attendance 55. Attendance ratio 0.22.

• **PITTSBURGH**—April 11, 1949. Problems in the design of piping systems were described by Walter W. Lige, of Bell & Gossett Co., Morton Grove, Ill. Gravity and forced hot water systems and radiant heating were some of the systems for which he pointed out sources of error in design.

Reports were made as follows: B. B. Reilly, treasurer; C. H. Schneider, chapter delegates, J. L. McCann, program for May meeting. Attendance 39.

• **ROCKY MOUNTAIN**—April 6, 1949. Two ASHVE members were featured speakers at the meeting in Denver, Colo. They were H. C. Day, American Radiator & Standard Sanitary Corp., Pittsburgh, and H. H. Herman, of Denver, Warren Webster & Co., Camden, N. J. Both spoke on radiant heating.

Mr. Day described the sensation of comfort as being an equilibrium between heat gains and losses, and pointed out the reasons for using baseboard radiation as a heating system to maintain comfort.

Mr. Herman defined baseboard radiation as perimeter heating to emphasize that radiation could come along outside walls as well as from floor and ceiling panels. He also showed slides depicting the application of types of baseboard radiation.

An invitation from the University of Denver branch of *ASME* to attend its April meeting was announced by Pres. Fred Janssen.

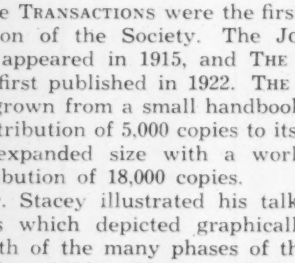
During the discussion which followed the talks, B. A. Brickham gave observations from his own experience regarding baseboard radiation. Attendance 46. Attendance ratio 0.65.

• **ROCKY MOUNTAIN**—March 16, 1949. At the March meeting in Denver, Pres. Fred Janssen introduced the speaker of the evening, A. E. Stacey, Jr., president of the Society and director of application engineering, Carrier Corp., Syracuse, N. Y. Mr. Stacey gave an historical survey showing how the development of the Society paralleled the development of the heating, ventilating and air conditioning field.

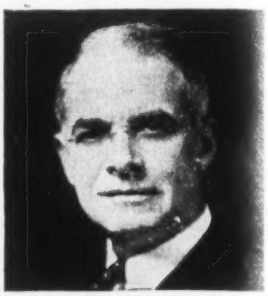
Mr. Stacey described the meeting of engineers in 1895 when the present name of the Society was first used. Here the purposes for which the Society was founded were promulgated. It was noted that even the first few members of the Society came from cities widely scattered through the eastern half of the United States. Today's membership of more than 6,700 represents a steady growth, with the exception of the years immediately following the 1929 depression.

The TRANSACTIONS were the first publication of the Society. The JOURNAL first appeared in 1915, and THE GUIDE was first published in 1922. THE GUIDE has grown from a small handbook with a distribution of 5,000 copies to its present expanded size with a worldwide distribution of 18,000 copies.

Mr. Stacey illustrated his talk with slides which depicted graphically the growth of the many phases of the Society's activities. Mr. Stacey's long association with the Society and the air conditioning industry enabled him to draw upon his many personal experiences to flavor the statistics which mark the progress of the Society through the years.



J. S. Locke
Minneapolis, Minn.



Alfred E. Stacey, Jr.
Syracuse, N. Y.

Chapter President Janssen thanked President Stacey for his interesting talk. Daniel J. McQuaid added some interesting sidelights on Society activities. Attendance 44. Attendance ratio 0.63.

• **ST. LOUIS**—April 5, 1949. Improved control systems are now used in railway car heating, said J. S. Locke in his address to the Chapter. Mr. Locke, representative of the Minneapolis-Honeywell Regulator Co., Minneapolis, covered a brief history of air conditioning and heating on railroads and pointed out that the modern controls resulted from cooperative investigation between railroads and manufacturers of control systems and air conditioning apparatus.

G. H. Bemarkt and W. A. Russell announced that the program for May would be a dinner dance on May 18, and an annual meeting on May 3, with Prof. R. H. Varney, Washington University, as speaker. F. E. Ince invited the Chapter to attend the coming *ASRE* meeting.

Other reports were given as follows: H. C. Sharp, finance; E. T. Clucas, attendance; M. F. Carlock, nominating committee; D. G. Carter, joint council of engineering society activities. Attendance 80.

• **SHREVEPORT**—April 21, 1949. The application of air conditioning to larger structures was discussed by E. A. Rapp, of the General Electric Co., Bloomfield, N. J., in a talk entitled *Air Conditioning in Multi-Room Buildings*. A discussion period followed his talk.

L. M. K. Boelter
Berkeley, Calif.

A report on Engineer's Day was given by Robin Hood. He spoke also of other student activities at Louisiana Polytechnic Institute, Ruston, La. Bernard Segall, Jr., reported that the annual picnic would be held in June, with the date to be announced later. Attendance 28.

• SOUTH TEXAS—March 18, 1949. Air conditioning in the Shamrock Hotel was one of the items on the program in Houston as Charles Kribs reported on the system used in the Hotel. Chester Blome spoke on the venting of gas fired equipment. After the talks, the two speakers conducted a question and answer period.

A. F. Barnes reported for the Engineers Council on the Symposium of April 2. D. M. Robinson made an announcement about next month's program and C. L. Fleming reported on membership. Other reports were given as follows: H. L. DeVines, the Chapter newspaper; R. J. Salinger, chapter delegates meeting at Chicago; D. M. Mills, the research program; Reg. F. Taylor, the Council Meeting at Chicago.

Attendance 64. Attendance ratio 0.23.

• SOUTHERN CALIFORNIA—April 20, 1949. Research was emphasized by two guest speakers, Dr. Baldwin M. Woods and Dr. L. M. K. Boelter, both of the University of California. Dr. Woods' subject was *The Value of Research to the Heating, Ventilating and Air Conditioning Industry*. He outlined the Society's policy with regard to research and gave a summary of what has been accomplished.

Dr. Boelter spoke on *The Method and Results of Research on a Particular Project*, pointing out that much study is required before a project can be started. The application of research results to industry was also explained. Leo Hungerford, chairman, H. M. Hendrickson and R. A. Lowe were appointed members of an advisory committee on heating and refrigeration inspection, as requested by a letter from the Los Angeles Dept. of Building and Safety. Attendance 56.

• SOUTHWEST TEXAS—April 12, 1949. Continuous air motion in a warm air heating system requires adequate control, John W. Norris told Chapter members gathered in Austin. Speaking of the circulation of warm air, Mr. Norris, vice president of Lennox Furnace Co., traced the development of the system from the gravity type to the use of blowers and concrete slab floors. Location of registers, he said, is less important with constant blower operation as long as air motion does not strike a human being. Air moved under floors and allowed to enter the rooms through slots under the window represents an improvement in warm air systems, Mr. Norris stated.

Telegrams from C. R. Gardner and R. F. Taylor were read. Attendance 42. Attendance ratio 0.73.

• SOUTHWEST TEXAS—March 31, 1949. Chapter members who attended the March meeting in San Antonio heard J. W. May speak on electrostatic filters and their operating characteristics. Mr. May, who is associated with the American Air Filter Co., Louisville, Ky., presented information about initial costs of installations and operating costs of conventional applications.

Reports were given on the 55th Annual Meeting at Chicago and on the 5th Air Conditioning Conference. Attendance 29.

• UTAH—April 11, 1949. The following officers for the year ending April 1950 were elected: *President*—C. E. Ferguson; *Vice President*—R. H. East; *Secretary-Treasurer*—A. R. Curtis.

H. G. Richardson, Jr., presented a color sound film on air conditioning and a discussion on the advancement of the industry followed. Mr. Richardson also reported on the Air Conditioning Conference held at Corvallis, Ore. Pres. E. J. Watts reviewed the Chapter's activities of the past year and the treasurer's report was read and approved. Attendance 21. Attendance ratio 0.49.

• UTAH—March 18, 1949. Progress of the ASHVE was described by A. E. Stacey, Jr., Society president, in a talk before the Utah Chapter in Salt Lake City. President Stacey reviewed the Society's activities and growth, particularly in the field of research, and stressed the importance of each member and chapter in the national organization.

Reports were made by Chapter Pres. E. J. Watts and J. L. Ashton. Attendance 25. Attendance ratio 0.58.

• VIRGINIA—April 11, 1949. Lester T. Avery, 1st vice president of ASHVE, was the guest speaker at the chapter meeting in Norfolk, Va. Mr. Avery's subject was *Air for Healthful Living*, giving some of his own observations of air cleaning during his engineering career.

Pres. J. E. White reported on

J. W. May
Louisville, Ky.

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T. H. Urdahl
Washington, D. C.

memberships and introduced the guest speaker. Attendance 15. Attendance ratio 0.45.

• **WASHINGTON, D. C.**—March 9, 1949. The design of an air conditioning system in a building must allow for Washington's unusually humid weather, T. H. Urdahl told his fellow members of the Chapter. Mr. Urdahl described the design for the use of desiccant dehumidifiers and of a circulating chilled water system for summer sensible cooling.

G. J. Simi, director of apprenticeship, U. S. Dept. of Labor, explained the work of his department and invited inquiries from employers and others. Pres. A. S. Gates, Jr., announced a joint meeting of several technical societies for next week and also spoke on Chapter memberships.

W. C. Reamy, Jr., chairman of the by-laws committee, read a petition proposing changes of the by-laws and rules. H. H. Hill gave the report of the nominating committee. Attendance 47. Attendance ratio 0.29.

• **WESTERN MICHIGAN**—April 11, 1949. The legal side of the industry was stressed by L. D. Smith, speaking at the April meeting held in Battle Creek. Mr. Smith discussed such aspects as partnerships, corporations, contracts, bankruptcy, negligence and insurance and pointed out the pitfalls to be avoided.

The business part of the meeting included the treasurer's report and announcements of coming events. The Semi-Annual Meeting of the Society in Minneapolis in June was announced. The nominating committee also made a report. Attendance 53. Attendance ratio 0.63.

• **WESTERN MICHIGAN**—March 22, 1949. Heating and ventilating research in England and the United States was outlined by Cyril Tasker, director of ASHVE Research, in a talk at Michigan State College, Kalamazoo.

He also showed slides of activities in the Society Laboratory in Cleveland, including radiant heating, solar heat transmission through glass, and oil combustion.

Members of the *National Warm Air Heating and Air Conditioning Association* were guests at the dinner meeting. During the dinner, musical entertainment was provided by students of the Michigan State College.

• **WESTERN NEW YORK**—April 25, 1949. *Theory of the Electrostatic Precipitation of Dust* was discussed by J. W. May, American Air Filter Co., Inc., Louisville, Ky., before 82 members and guests in Buffalo. Joseph Davis gave a report on the Committee on Research. An unannounced highlight in the program occurred when Cecil W. Farrar, pioneer of the Chapter, was ushered to the speaker's platform and applauded by the group for having completed his 25th year in the Society. Mr. Farrar then spoke, giving reminiscences about the Chapter and the Society. Attendance 82.

Cecil W. Farrar
New York, N. Y.

• **WESTERN NEW YORK**—March 14, 1949. Thomas Eagan, of Washington, D. C., spoke about the contractor's profession at the meeting in Buffalo. Mr. Eagan, president of the *Heating, Piping and Air Conditioning Contractors National Association*, outlined the purposes and accomplishments of the Association. In the discussion period that followed, Mr. Eagan and Joseph Davis brought out important legal points in the operation of industries.

Pres. Edwin Woolcock read letters of thanks from Dean Mohn, University of Buffalo, and Mr. Marsh, N. Y. State School of Applied Arts and Sciences. A letter from the Toronto Chapter was also read. Attendance 48.

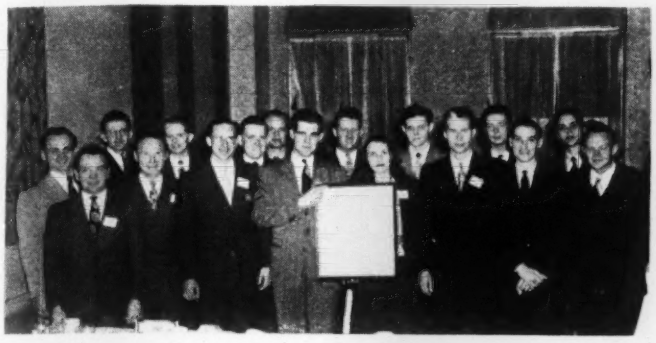
• **WISCONSIN**—April 25, 1949. A resolution expressing sympathy to the family of the late Harry W. Ellis was passed by the Chapter at its meeting at the University of Wisconsin, Madison. Mr. Ellis, who died on April 1, was an outstanding member of the Wisconsin Chapter.

Speaker of the evening was Cyril Tasker, director of ASHVE research. Mr. Tasker reviewed his trip to England and described the work done abroad in domestic ventilation. He also outlined several projects now going on at the Society's Laboratory in Cleveland.

An outing committee to arrange for the annual picnic was announced and consists of L. C. Plaehn, chairman; E. A. Knab and K. A. Leitgabel. Announcement of the May meeting with ASHVE president, A. E. Stacey, Jr., as speaker was made by W. A. Ouweneel, Chapter president.

I. J. Rossiter and E. C. Youngman were appointed to an auditing committee. Attendance 52. Attendance ratio 0.28.

• **WISCONSIN**—March 16, 1949. One hundred and forty-four engineers attended the joint dinner meeting of the Wisconsin Chapter of the ASHVE, the *Engineers Society of Milwaukee* and the Wisconsin Chapter of the *ASRE*.



Members of the Oregon State College Student Branch Receive Charter

Arrangements were in charge of the *Engineers Society of Milwaukee*, and the meeting was called to order by its president, Lawrence Petersen, at 8:00 p. m. The speaker of the evening was Marshall G. Munce, Vice President of the York Corp., York, Pa., on the subject, *The Engineers' Stake in the American Way of Life*. Mr. Munce spoke from his experience both here and in Britain as an executive of his company. He stressed income, position in our work and improvement in standards of living as the driving forces in the American way of life. Attendance 144. Attendance ratio 0.23.

Student Branches

▲ NORTH CAROLINA STATE COLLEGE—April 12, 1949. A description of several air conditioning installations was given by W. D. Graham, speaking before the students at Raleigh, N. C. Engineer for The Trane Co., Greensboro, N. C., Mr. Graham pointed out practical considerations and problems encountered in the industry. Questions from the audience were answered by the speaker during the discussion period.

Reports on student branch matters were made by Pres. J. G. Marshall and by the entertainment committee. Attendance 65. Attendance ratio 1.0.

▲ TEXAS A. & M. COLLEGE—March 24, 1949. At the student meeting in College Station, Tex., W. R. Horsley, director of the A. & M. Placement Office, stressed the importance of a definite goal in job procurement. He pointed out that intangible qualities can affect the interviewer or prospective employer.

Prof. L. S. O'Bannon spoke briefly about the Air Conditioning Conference at A. & M. Attendance 32. Attendance ratio 0.51.

PAPERS FOR FUTURE PROGRAMS

The Program and Papers Committee is desirous of securing papers for consideration by the Publication Committee, so that an interesting and varied program of technical subjects can be presented at the 56th Annual Meeting in Dallas, Tex., January 23 to 26, 1950.

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It is indicated that the major interest of the membership, as a whole, seems to rest in the following subjects in the order named:

1. Panel or Radiant Heating
2. Panel or Radiant Cooling
3. Heat Pump
4. Noise Control
5. Odors and Odor Control
6. Air Sterilization
7. Air Cleaning in Ventilation
8. Solar Radiation
9. Performance of Outlets (Air Distribution)
10. Influence of Humidity (Comfort and Health)
11. Influence of Radiation (Comfort and Health)

There are, of course, other subjects on which papers will be welcome so they need not necessarily be confined to those listed.

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ASHVE members are cordially invited to submit papers for review. Papers having joint authorship will be acceptable. Manuscripts received by October 15, 1949 will receive consideration for annual meeting presentation. Any member intending to submit a paper, should notify the Secretary of the Society at the headquarters office in New York, who will furnish the necessary information regarding preparation and submission of manuscript.

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Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 145 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by June 25, 1949, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ABBS, WILLIAM, Htg. Sales Engr., Reichle Supply Co., Saginaw, Mich. PROPOSERS: L. A. Burch, F. X. Marzolf. SECONDERS: J. E. Thomas, R. L. Deppmann.

ADAMS, J. G., Refrig. & Air Cond. Engr., Stephens Bros., Inc., Memphis, Tenn. PROPOSERS: J. B. Lammons, R. W. Johnson. SECONDERS: C. S. Fischer, W. E. Thorpe.

AUSTIN, W. F., Chief Engr., Metromatic Mfg. Co., Everett, Mass. PROPOSERS: J. R. Murphy, E. T. Houlihan. SECONDERS: H. A. Essley, R. T. Schoerner.

AVERA, A. S., Partner, Stanley Equipment Co., Bryan, Tex. PROPOSERS: D. M. Mills, W. J. Way. SECONDERS: J. B. Buckley, Norman Way.

BAER, J. H., Owner, Jerry Baer Heating Co., Minneapolis, Minn. PROPOSERS: L. K. Reisberg, W. N. Parks. SECONDERS: W. F. Uhl, C. G. Burritt.

BARBARA, R. B., Pres., T. J. Conner, Inc., Cincinnati, Ohio. PROPOSERS: K. B. Little, G. T. Donovan. SECONDERS: J. J. Bechtol, H. A. Pillen.

BARBER, T. R., Gen. Mgr. & Secy.-Treas., G. A. Barber & Sons, Ltd., Toronto, Ont., Canada. PROPOSERS: Arthur Nearingburg, G. S. McKernan. SECONDERS: C. W. Gordon, W. P. Elms.

BEVIRT, W. D., Engr. & Estimator, D. F. Edwards Heating Co., St. Louis, Mo. PROPOSERS: C. F. Combs, S. J. Heiman. SECONDERS: E. E. Carlson, G. W. F. Myers.

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COOPER, F. H.
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HALL, L. F.
HARRINGTON, T. A., JR.
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POSEY, W. P.
SMATHERS, D. J.
STROUPE, E. A., JR.
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WALLER, L. H.
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KRUSE, H. W.
LEVENHAGEN, J. I.
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COUNTRY'S LARGEST HEAT PUMP

Was Unperturbed in Record Cold Spell

The heat pump system in the Equitable Building, Portland, Ore., largest in the country, took the long cold spell of the winter of 1948-49 in stride, but many domestic systems suffered, as reported in the Oregon Journal of Portland.

During the winter, many of the ground coils used with residential heat pumps took a good deal of heat from the ground and froze large parts of the owners' yards so solid that ridges a foot high or higher bulged up, even cracking garage floors. Heaving by frost around the coils caused some buildings to be thrown out of line.

In such cases, during the coldest spell since 1893, the residents had to use electric heaters, fireplaces, and open ovens day and night to maintain temperatures at a few degrees above freezing. On the other hand, those homes using well water rather than a ground coil were kept comfortable throughout the winter.

In another case, however, the temperature of a 3-bedroom house was maintained at 74 F during the day and 70 at night. But this house did not use a ground coil as a heat source. A city water tap was used. It is an unusual case, being a test model for a distributor wishing to estimate the cost of water as a heat source.

But other heating systems were not immune to trouble. During the cold spell, panel heating had its *bugs*, particularly in the matter of control. Yet, though some owners were shivering, one angry housewife complained: "The house is 85 degrees and how do you shut it off?" Control valves were the answer in this case.

And even the conventional systems using oil, gas or hard fuel suffered,—by way of the pocketbook.

SPACE HEATERS BEST IN CENTER OF HOUSE

Jacketed space heaters proved superior to radiant space heaters in producing more uniform temperature distribution from the center of a small house, according to an investigation by the National Bureau of Standards.

The need for such an investigation was indicated by the Housing Census of 1940, which revealed that 35 percent of all urban homes and 63 percent of all rural homes were heated by various types of space heaters.

During cold weather, when the temperature outside was 0 F, the space heaters gave comfort for about a 7-foot radius. When the outside temperature was 50 F, the radius being comfortably heated was 35 ft.

OBITUARIES

GEORGE W. BARR

George W. Barr, Life Member of the Society since 1938, and district manager of the Philadelphia office of Aerofin Corp., died on April 23, 1949. During his lifetime, Mr. Barr rendered distinguished service to the Society. He was a member of the Board of Governors (former Council) in 1910 and was the first chairman of the Society's Research Committee. It was Mr. Barr who investigated the possibility of establishing the Society's Research Laboratory. In 1916 he was elected secretary of the Eastern Pennsylvania Chapter (now Philadelphia Chapter) and in 1917 he served as its president.

Mr. Barr was born in 1873 at Bryn Mawr, Pa., and after graduating from West Philadelphia Friends School and Haverford Grammar School, he received his technical training at Princeton University.

After a period of employment with Herendeen Mfg. Co., Geneva, N. Y., he entered the firm of Isaac A. Sheppard & Co., Philadelphia, becoming its manager in 1903. In 1911 he was appointed manager of the Philadelphia Branch of U. S. Radiator Corp., and in 1916 he joined the Federal Radiator Co. of New Castle, Pa. From 1917-1919 he was

G. W. Barr

in the Ordnance Department of the U. S. Army and was discharged as a major. In 1920 he was made sales manager for Hersh Brothers Co., Allentown, Pa., remaining with them until 1922, when he became president of the Roach Stoker Co., Philadelphia.

Mr. Barr also served as assistant general sales manager for Hoffman Specialty Co., and as associate manager of sales for Fitzgibbons Boiler Co., both in New York. For a time he was general sales manager for the Circulair Heat, Inc., in their New York office. In 1929 he joined Aerofin Corp., as district engineer, and in 1931 became district manager of the Philadelphia office, which position he held until his death.

Mr. Barr joined the ASHVE in 1905 and for many years was a familiar Society figure, regularly attending both Annual and Semi-Annual Meetings.

Mr. Barr was a member of the University, Merion Cricket, Princeton and Nassau Clubs, and of the Military Order of Foreign Wars. He is survived by his wife, Ethel S.; a daughter, Ethel; two sons, George B. and Lawrence, and five grandchildren.

FRANK J. HELLE

Word has reached the Society of the sudden death of Frank J. Helle, St. Louis, Mo., at the age of 34.

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Mr. Helle joined the Society in 1947 and at the time of his death was associated with Republic Heaters Co., Chicago. His work there involved sales and supervision of installation and service of domestic heating systems.

He was a veteran of World War II, with nearly four years of service with the U. S. Army.

MICHAEL H. GORNSTON

Michael H. Gornston, Life Member of the Society, and a resident of Forest Hills, N. Y., died April 30, 1949, at the age of 77.

Mr. Gornston was a specialist in steam engineering and had been

M. H. Gornston

custodian engineer in the New York City Dept. of Education from 1902 to 1941. He was the author of *The Operating Engineer's Catechism of Steam Engineering.*

His experience began with steam engineering for the Woodbine Machine & Tool Co., Woodbine, N. J. Then he was engineer for an apartment building, and in 1902 he entered public school engineering. For a time he was in charge of heating and ventilating for the largest elementary school in the world.

At the time of his retirement in 1941 at the age of 70, Mr. Gornston was honored by Board of Education employees and was the subject of an article in the Daily News, New York City.

He is survived by his wife, Ethel, and by two sons, David and Seymour F.

OBITUARIES

HARRY W. ELLIS

Harry W. Ellis, Milwaukee, chairman of the board of Johnson Service Co., Milwaukee, and a member of ASHVE, died on April 1 after a brief illness. He was 84.

Well known in the air conditioning field, Mr. Ellis remained active in his post as board chairman following his partial retirement in 1938

H. W. Ellis

after serving 25 years as president and general manager.

Mr. Ellis was born in Milwaukee in 1865. Entering the employ of the Evening Wisconsin at an early age, he was a salesman until 1894 when he was associated with Warren S. Johnson, founder of the Johnson Services. After some years as Chicago manager of the Johnson Co., Mr. Ellis became, in 1912, president and general manager.

He was a charter member of Battery "A," Wisconsin Artillery, serving as a lieutenant and captain. He attained the rank of colonel in the Mexican Border trouble of 1916, and served in that capacity during World War I.

He is survived by his wife, two daughters and four grandchildren. Mr. and Mrs. Ellis would have celebrated their golden wedding anniversary in a few months.

HERBERT G. THOMAS

Herbert G. Thomas, consulting engineer at Chicago, Ill., died on April 10 at the age of 65. He was a past president of the Illinois Chapter ASHVE.

Mr. Thomas was a native of Illinois and attended the University of Illinois in Urbana. His early experience was as estimator, draftsman and designer for J. G. Fitzgerald, Lake Forest, Ill. In 1912 he became Chicago representative of the Moline Heat Co., Moline, Ill., and later was associated with the Robinson Furnace Co., with the Newport Boiler Co., and with Warren Webster & Co., all of Chicago.

ANDREW G. OREAR

Word has been received of the death of Andrew G. Orear, Glendale, Calif. He was 59 years of age

A. G. Orear

and a member of the Society for a period of 19 years.

Mr. Orear was born in Columbia, Mo., in 1891 and attended Missouri State University. He began his engineering career in 1910 with Julius Andrae & Sons Co., Milwaukee, Wis. In 1922 he entered the Illinois Electric Co. as a specialist and sales engineer of power apparatus and ventilating equipment.

He was district sales engineer for the Ilg Electric Ventilating Co., Los Angeles, Calif., from 1927 to 1932. In 1933 he was manufacturer's agent for The New York Blower Co. and the L. J. Wing Mfg. Co.

Mr. Orear organized and became part owner of Trade-Wind Motorfans, Inc., Los Angeles. He held several patents on fan equipment and at the time of his death was president of the firm.

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● **SOUTHWEST TEXAS:** Organized 1948. Headquarters, San Antonio, Tex. Meets, Second Tuesday. President, G. R. Rhine, 1208 Alamo National Bldg., San Antonio. Secretary, I. W. Wilke, P.O. Box 1155, Austin 3.

● **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, C. E. Ferguson, 878 E. Gayfield Ave., Salt Lake City. Secretary, A. E. Curtis, 2211 Highland Dr., Salt Lake City.

● **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. President, J. E. White, 7607 Gloucester Ave., Norfolk 5. Secretary, D. E. Phillips, P.O. Box 674, Newport News.

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● **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, F. J. Weber, 443 Delaware Ave., Buffalo 2. SECRETARY, J. M. Quackenbush, 610 Linwood Ave., Buffalo.

● **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, B. M. Kluge, 1817 S. 66th St., Milwaukee 14. SECRETARY, J. A. Lofte, 9121 W. Hawthorne Ave., Milwaukee 13.

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● **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. Chairman, M. E. Naftzger, FPHA 228-2 State St., W. Lafayette. Secretary, C. M. Wade, The Maples Trailer Camp, Lafayette.

● **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, C. V. Brown, Mech. Engrg. Dept., Texas A. & M. College, College Station. Secretary, R. N. Hughes, Box 914, College Station.

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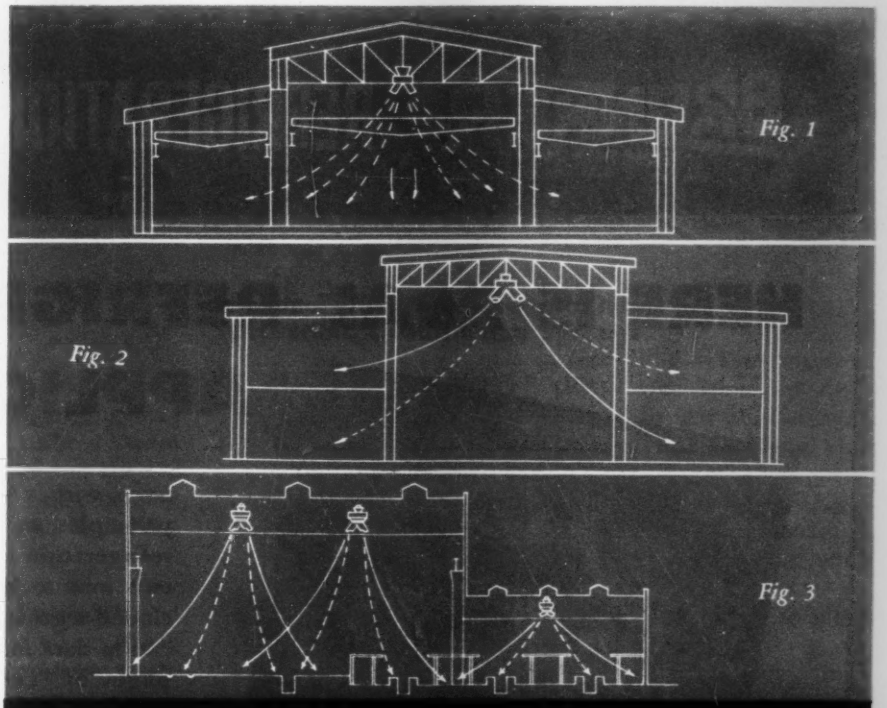
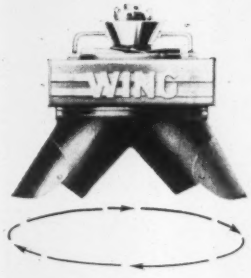
Wing Revolving Unit Heaters Insure Complete, Thorough Heat Coverage

Wing Revolving Unit Heaters draw the air from the roof or ceiling, pass it through the Wing Featherfin Heating Section, and project the resultant heated air through slowly revolving discharge outlets to the working level below. As the moving warm air reaches the working level, it mixes uniformly with the cold air, circulates around bulky machinery or other obstacles and penetrates into cold, damp corners, repair pits, etc. Thus is assured a comfortable, uniform temperature throughout the entire plant, a condition not attainable with the single-direction discharge of the ordinary unit heater. The effect on the worker, because of the gentle air motion, is a pleasing sensation of fresh, live, invigorating warmth.

The Wing Revolving Unit Heater is available with three different types of revolving discharge outlets, to suit the varying requirements of buildings and rooms of different heights and shapes. An additional feature of the Wing Revolving Unit Heater is its use for summer cooling. With the steam turned off and the fan on, the revolving discharge outlets provide an equally pleasant cooling effect. Wing Revolving Unit Heaters are also available in Turbine Driven and Gas Fired models. Other Wing Unit Heaters include Fixed Discharge Unit Heaters for special applications, storage garages, etc., High Velocity Unit Heaters for covering door openings, and Utility Unit Heaters (horizontal discharge) for installation in churches, offices, etc. where quiet operation is required.



Only Unit Heaters That Revolve Can Overcome These Heating Problems Efficiently and Economically



The Wing Revolving Discharge Outlets turn slowly through a complete circle about once every two minutes, affording complete coverage, avoiding concentrated blasts of air and providing a pleasant, healthful working atmosphere.

Illustrated above are three typical buildings which present heating problems that cannot be overcome by ordinary unit heaters with efficiency and economy. In Fig. 1, Wing Revolving Unit Heaters are located high in the center and out of the way of cranes. From this height they project the heated air slowly through 360 degrees, covering successively the central portion and the bays with equal thoroughness. The heated air moves around and under obstructions, reaching to walls and remote corners. Every part of the plant is thus kept at an even, comfortable temperature.

In Fig. 2, two floor levels are perfectly heated with only one line of Wing Revolving Heaters. This is accomplished by adjusting the discharge outlets so that one outlet covers the upper floor or balcony while the other covers the ground floor.

Fig. 3 is a railroad repair shop. This building is perfectly heated despite the massive obstacles, repair pits, etc., in it.

For further details write for Bulletin HR-5.

L. J. Wing Mfg. Co.
14th St. & 7th Ave., New York 11, N.Y.

Factories: Newark, N. J. and Montreal, Can.

Manufacturing Licensee for Wing Unit Heaters in Western Europe -
WANSON
9, rue Mogador, Paris 9e, France
222, rue Royale, Brussels, Belgium

WING

Wing
Revolving UNIT HEATERS

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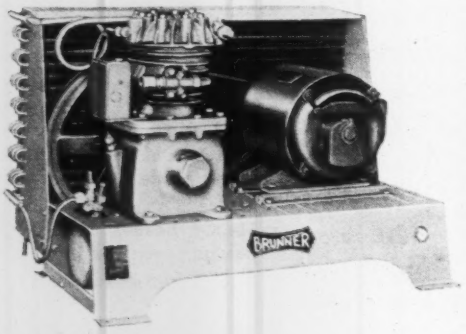
HERE IS REAL REFRIGERATION APPLICATION HELP!

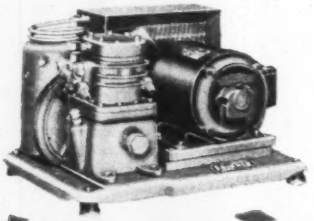
Even with a sound knowledge of refrigeration principles and a broad installation experience, refrigeration men rarely find the answers on any two jobs to be alike. That is why we have included a great deal of helpful, time-saving application data in this new Brunner catalog. Several pages of "cross section" illustrations help in showing customers exactly why you recommend a certain size and type of condensing unit.

Equally important are 22 pages of illustrations and capacity data on all the Brunner air and water cooled refrigeration condensing units.

BRUNNER MANUFACTURING CO.
Utica 1, New York, U.S.A.

● **TO RESPONSIBLE REFRIGERATION MEN,** this data will prove valuable. A note on your letterhead will bring a copy by return mail. No charge.





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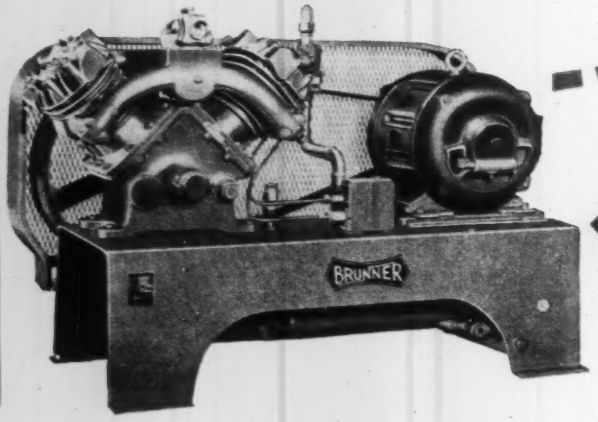
...a size and type for every purpose



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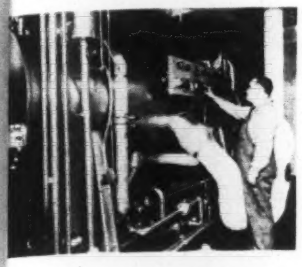
AIR AND WATER COOLED MODELS
¼ HP. TO 30 HP.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1949 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Employs Steam in Absorption Machine for Air Conditioning Refrigeration



No. 4055—A new absorption type refrigerating machine which utilizes steam is being produced in 115, 150 and 200 ton capacities by Carrier Corp., 302 S. Geddes St., Syracuse, N. Y.

Representing more than eight years of research and development, the unit is designed to operate on either high or low pressure steam (including low pressure waste steam) and uses plain water as the refrigerant and a simple salt as the absorbent. Water to be chilled is sprayed into a flash evaporator located in the upper portion of the absorber-cooler shell which is maintained at a high vacuum. A portion of the chilled water evaporates and cools the remaining water. The chilled water drains from the cooler tank and is pumped to the load. The temperature of the chilled water leaving the machine depends on the concentration and temperature of the salt solution sprayed over the coil located in the lower portion of the shell, which forms the absorber section. The salt solution absorbs the water vapor flashed in the evaporator, and the heat of absorption of this vapor tends to raise the temperature of the solution, which is therefore cooled by water passing through the absorber coil in order to maintain the solution at the proper temperature.

Absorption of the water vapor reduces the salt concentration of the solution, thus reducing its absorbing power. Accordingly, the weak solution is continually drained from the absorber shell and delivered by the solution pump to the upper shell for re-concentration. Steam, admitted to the tubes of the generator section of the upper shell, heats the solution and boils off the water vapor previously absorbed in the absorber section, thus restoring the original concentration.

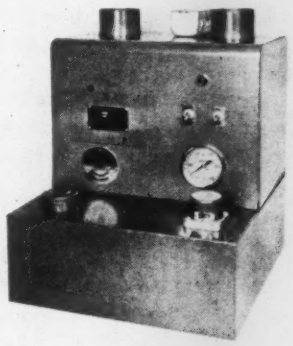
Results obtained in a number of installations throughout the country indicate numerous advantages, says the company. Most obvious is the fact that it can be used to balance steam loads for summer cooling and winter heating. It is said to be especially suitable for use in areas where steam can be produced at relatively moderate costs, where there are district steam plants, where natural gas is available, or where a steam plant is relatively idle in summer.

Other advantages are said to include relatively noiseless and vibrationless operation (there are no moving parts except for a small solution pump), adaptability to installation on rooftops or intermediate floors because of its light weight and compact design, and steam consumption of less than 20 lb per hr per ton of refrigeration—no matter what the steam pressure.

The machine will bring water temperatures down to 36 F and is said to automatically adjust itself to partial loads down to 15 percent of total capacity without loss of efficiency.

Shown here is a 150 ton machine which has been in operation in the Consolidated Edison Co. building, New York City, since 1946. Steam is supplied by New York Steam Corp. The first multi-unit installation was completed last summer in the First National Bank building, Oklahoma City.

Introduces Triethylene Glycol Into Ventilation, Conditioning Systems



No. 4056—The model ARA-4 vaporizing unit developed by Air Purification Service, Inc., 82 Plane St., Newark 2, N. J., is designed to introduce triethylene glycol, in controlled amounts, into air conditioning and ventilation systems so as to reduce the number of airborne bacteria.

The unit has no moving parts, vaporization being accomplished by means of electrical heat thermostatically controlled and glass wick action. According to the manufacturer, the air stream (about 15 cfm) leaving the device is substantially saturated with glycol. A dial thermometer on the unit is used to determine air temperature which may be varied and which is said to indicate the absolute quantity of glycol being introduced into the system.

In the illustration, the air inlet nipple is at the left and the vapor outlet nipple is at the right. Inasmuch as there is no fan in the unit, the vaporizer operates with air induced by a pressure drop within the ventilation or air conditioning system. In general, this indicates location on the suction side of the system fan. Under certain conditions, however, it may be connected on the pressure side.

Heating, Piping & Air Conditioning **[6-49]**
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

4055	4056	4057	4058	4059	4060	4061	4062	4063	4064
4065	4066	4067	4068	4069	4070	4071	4072	4073	4074
4075	4076	4077	4078						
7262	7263	7264	7265	7266	7267	7268	7269	7270	7271
7272	7273	7274	7275	7276		7278	7279	7280	7281
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7292	7293	7294	7295	7296	7297	7298	7299	7300	7301
7302	7303	7304	7305	7306	7307	7308			

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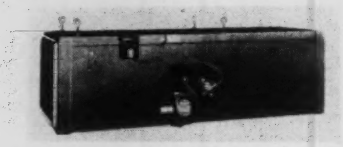
Oil Fired, Suspension Type Heater Features Compact Design, High Efficiency

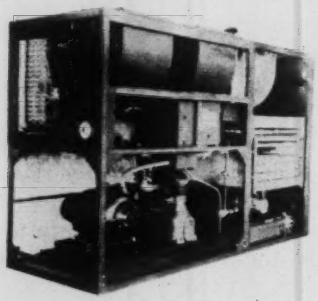


No. 4057—A new line of oil fired, suspension type heaters, with capacities from 85,000 to 400,000 Btu per hr, has been developed by Jackson & Church Co., 321 N. Hamilton Ave., Saginaw, Mich.

The steel casing, heater section, centrifugal blower and motor, oil burner, air filter, and controls are assembled at the factory. Dimensions of the model OL-180-S unit (180,000 Btu per hr capacity) are 23 x 27 x 74 in., and the weight is 575 lb. A two stage fuel pump is used and is said to be sufficient for practically all ceiling installations. Eye bolts at four points assist in hanging.

According to the company, adequate air movement is assured over the entire heating surfaces and tests are said to have indicated efficiencies as high as 89 percent.

Packaged Air Conditioners Offered in 5 to 40 Ton Sizes

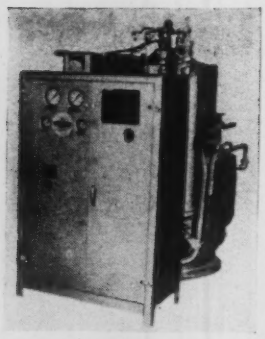


No. 4058—Baker Refrigeration Corp., South Windham, Me., has developed a new line of year 'round, central station, packaged air conditioners in eight sizes ranging from 5 to 40 tons capacity. These "Central-Air" units are designed to provide the advantages of central station operation with relatively low installation and engineering costs.

Completely self contained and with fully automatic controls, the conditioners are primarily designed for remote installations with wall ducts. However, cabinets are insulated against noise so that they are said to be practical for open installation where large single rooms, such as auditoriums, are to be conditioned.

Normally, units are supplied completely assembled and tested. However, where small entrances in a building are encountered, they can be shipped in separate sections. "Freon" is used as the refrigerant.

Generates Steam Rapidly

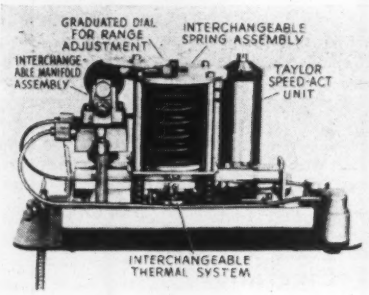


No. 4059—The new "Intensi-Fired" steam generator developed by Vapor Heating Corp., 4501 W. 16th St., Chicago, is said to develop 200 psi within 2 min from a cold start.

Hot gases from the combustion of atomized diesel oil are said to release 1,000,000 Btu per hr per cu ft of fire box and to wipe over 500 ft of seamless steel tube coils, developing 2500 (plus 20 percent) lb of steam per hr. One electric motor operates the fuel and water pump, blower, and ignition system.

Designed for working pressures from 75 to 200 psi, it is constructed in accordance with ASME and Hartford steam boiler codes.

Temperature Transmitter Highly Responsive



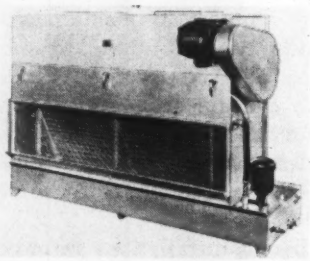
No. 4060—A new force-balance type pneumatic temperature transmitter called the "Transaire" has been developed by Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

This instrument is designed particularly for those applications where it is desirable to have the indication, record, or control remotely located from the point of measurement and where it is necessary to have accuracy, high speed of response, small thermal elements and short range spans within the limits of -375 F and 1000 F.

One of the outstanding features is said to be the incorporation of "speed-act" which applies the principles of "pre-act" or derivative action directly to temperature determination. This is designed to overcome the lag inherently present in the response of any form of thermal measuring element and to make possible "a quality of measurement not before attainable with any temperature measuring elements, particularly those requiring separable wells."

For the detection of process temperature variations, it employs advanced force-balance principles, its output in psi being proportional to the temperature of its thermal element. By means of ¼ in. O D copper tubing, says the manufacturer, this pressure change can be transmitted to a recording or controlling receiver remotely located as far as 1000 ft away, and even farther depending on conditions.

Evaporative Condenser Has Glass Fiber Eliminators, Continuous Coil



No. 4061—A new line of evaporative condensers with 5 to 40 ton capacities has been introduced by the Bush Mfg. Co., Hartford, Conn.

Welded steel angle irons and steel for the frame and sump pan are hot dipped galvanized after fabrication. Inside surfaces are coated with bitumastic compound to prevent corrosion. Larger units are built in sections which can be moved through standard doorways.

Standard construction features of the new line include glass fiber eliminator sections (in 20 to 40 ton units) for removal of entrained water droplets and centrifugal pumps with integral vertically mounted motors (in 5 to 15 ton units) with the inlet at the bottom of sump. A continuous tubing coil is used to eliminate return bends and the entire coil assembly is tested at 300 psi and can be split into separate circuits when desired.

[*Continued on p. 176*]

IMPROVE YOUR KNOWLEDGE OF AIR CONDITIONING

SEND TODAY FOR
Samuel R. Lewis'

"AIR CONDITIONING FOR COMFORT"

288 Pages—6¼" x 9¼"—Illustrated—
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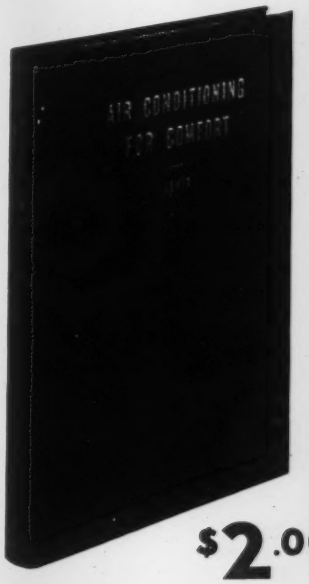

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Here is a book that presents—in simple, readily understandable form—every kind of information necessary for an accurate and thorough knowledge of air conditioning principles, equipment and practices. Written by S. R. Lewis, a widely-known consulting engineer who has been active in air conditioning work for more than thirty years, it deals with all angles of the air conditioning subject from the practicing engineer's viewpoint. The designing procedures explained in the book are, for example, in every detail the same procedures employed today by the author's own organization.

Featuring this third edition are chapters on phases of the subject not previously treated, including noise control, air conditioning measurements, air conditioning standards, fire protection codes and operating suggestions. Several complete examples of correct design procedure are given, together with forms for recording the design data, the proper filling-in of which are explained step-by-step.

The chapter devoted to Psychrometry presents nineteen different formulas for psychrometric calculations. In illustrating the correct use of these formulas, Mr. Lewis applies both the psychrometric tables and charts in order to render both devices thoroughly understandable.

OF VALUE BOTH AS A REFERENCE AND TEXT

Engineers in air conditioning will find the "Air Conditioning for Comfort" invaluable as a reference book, while salesmen, students, and others may rely on it to give them a clear knowledge of fundamentals, and of air conditioning methods and equipment.

Send for a copy today. We know you will consider this volume one of the most readable and complete books on the air conditioning science you have yet seen. You will risk nothing in ordering a copy, for you will be privileged to return it for a refund if for any reason it should prove unsatisfactory. Use the coupon at the right to order your copy now.

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CONTENTS

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CHAP. 2—Heat and Air
CHAP. 3—Air Conditioning Standards
CHAP. 4—Air Conditioning and the Human Body
CHAP. 5—The Psychrometric Table and Chart
CHAP. 6—Humidity Controllers and Control
CHAP. 7—Heat Transmission Through Barriers
CHAP. 8—Ventilation, Solar and Appliance Heat
CHAP. 9—Heating Systems
CHAP. 10—Air Conditioning Systems
CHAP. 11—Air Conditioning Apparatus
CHAP. 12—Refrigeration and Refrigerants
CHAP. 13—Refrigeration Compressors and Condensers
CHAP. 14—Refrigeration Evaporators and Auxiliaries
CHAP. 15—Record Forms for Heating and Cooling
CHAP. 16—Air Distribution
CHAP. 17—Water in Air Conditioning
CHAP. 18—Noise and Its Control
CHAP. 19—Air Conditioning Instruments and Measurements
CHAP. 20—Codes and Operating Suggestions
10" x 16" Psychrometric Chart..... Inside Back Cover

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Enclosed is $2.00 for a copy of AIR-CONDITIONING FOR COMFORT. If this book should prove unsatisfactory, I will return it within 15 days for a refund.

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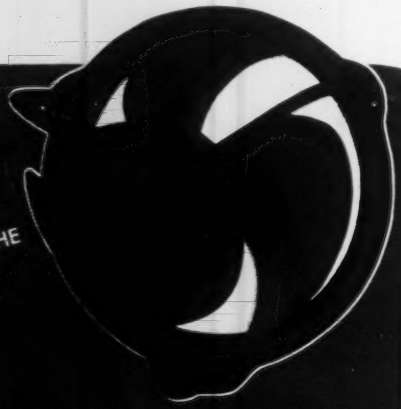


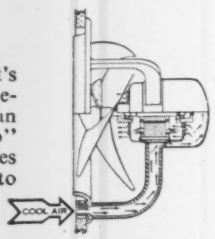
BIGGEST NEWS SINCE THE INVENTION OF THE SELF-COOLED MOTOR!

NEW TYPE "Q" SELF-COOLED MOTOR PROPELLER FAN

ILG VENTILATION

It's NEW from motor cover to frame, yet it's proved in thousands of installations! Certified ratings testify to remarkable capacity. Decibel ratings vouch for amazingly quiet operation. All ILG's famous features for high efficiency, power-saving economy, minimum maintenance and long life are built in. Now available in all sizes up to and including 30" fan wheels. Hurry—get the complete story in ILG Catalog No. 148—send coupon or phone nearby Branch Office (consult classified directory).

Specify the Self-Cooled Motor—it's exclusive, patented, ILG-built. Designed specifically for exhaust fan duty. Motor never "gums-up" from contact with foul air, requires minimum maintenance, adds to long life of entire unit.



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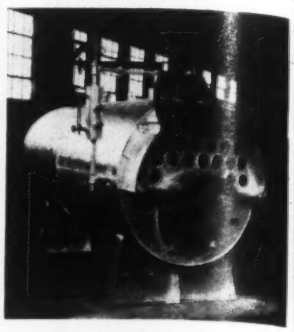
City.....*State*.....

[*Continued from p. 170*]

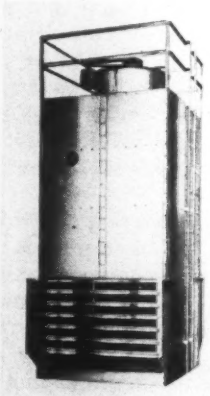
Scotch Marine Type Boiler Designed for Many Uses



No. 4062—The "Scot" low pressure, commercial Scotch marine boiler is of the wet base type and is designed for use with oil or gas. Crotty Mfg. Corp., 133-15 35th Ave., Flushing, N. Y., especially recommends this unit for use in apartments, laundries, and commercial and industrial plants. Various sizes are available in capacities from 1200 to 5000 sq ft of steam.

An unusually low water line is said to make it ideal where headroom is limited. It is made of rolled and welded extra heavy tubes and heavy boiler plate, in accordance with the ASME code. Submerged or external water heating coils are optional.

Cooling Tower Available in Wood or Steel Construction



No. 4063—Marley Co., Inc., Kansas City, Kans., has added a new cooling tower, the "Verflow", to its line of water cooling equipment. Designed in wood or steel, it is said to contain features previously found only in heavy duty industrial, high-priced towers.

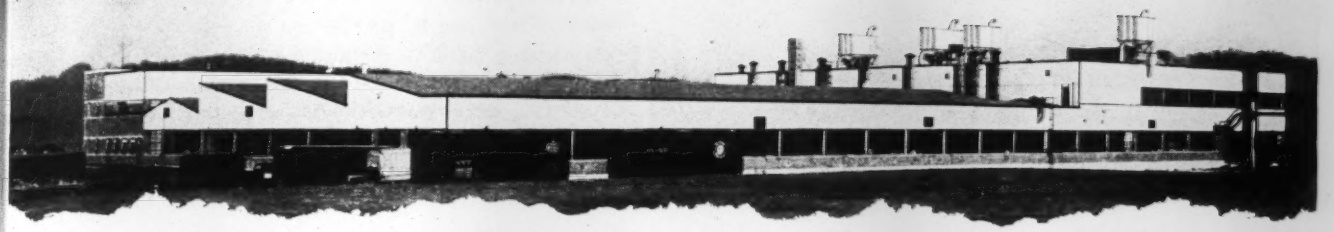
Features of these medium to large capacity towers which are stressed by the manufacturer include "lifetime" nail-less filling, balanced spray system with the company's patented low pressure nozzles, an access port to inspect and clean nozzles, a totally enclosed motor, enclosed bearing housing with grease packed bearings, air foil section cast aluminum alloy fans, special corrosion resistant paint on metal towers, heavy double sheathed wood casing on wood towers, hinged louver frames and removable louvers, and complete basin fixtures.

Offers Standardized Turbine for High Speeds and Wide Speed Ranges

No. 4064—A new standardized type DR mechanical drive turbine designed for high speeds, wide speed ranges, and greater accuracy of control has been developed by the turbine division of General Electric Co., Schenectady 5, N. Y. This standardized design, says the company, can power many drives formerly handled only by custombuilt units.

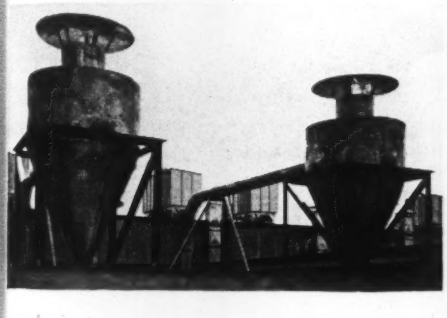
Speed range is controlled by a position restored oil relay governor providing adjustable speed ranges up to 5 to 1. This is said to be sufficient to handle all types of variable speed pumps, fans, compressors, blowers, stokers, etc. A steady state accuracy within 0.25 percent is claimed. Ratings up to 1500 hp are available with speeds from 1000 to 8000 rpm.

Again it's the LIGHT METAL selected as the RIGHT METAL



FOR THIS IMPORTANT CONSTRUCTION AT A B. F. GOODRICH PLANT

The Huffman-Wolfe Co. of Columbus, Ohio, contractors for this interesting installation at the Plastic Products plant of B. F. Goodrich Company in Marietta, had definite reasons for choosing Reynolds Aluminum. This picture story tells why sheet metal men are turning to aluminum as the right metal for more and more jobs.



Aluminum dust collectors save plastic trimmings for reprocessing. This metal rules out red-rust, solves the big cost of continued repainting.

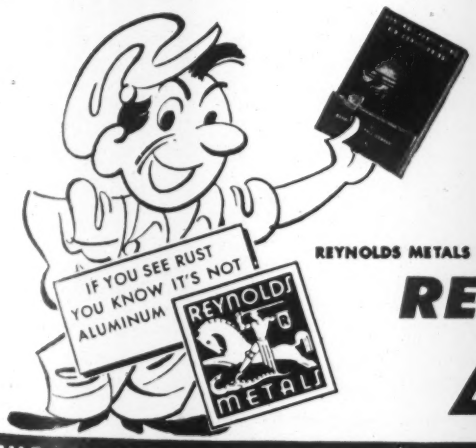
Reynolds Aluminum is the right metal from a profit standpoint, too. When you add up the advantages of aluminum, the total reads "profit." Three times the working metal per pound—more complete shop fabrication—speed in handling and erecting are exclusive advantages of this lighter, longer-lasting metal.

Special benefits are reported with each new use of *Lifetime* Aluminum for sheet metal construction. The picture report here shows how aluminum is the right metal for you when the job has to be RIGHT. Since it costs no more, why not use the best and the easiest metal to work with . . . use Reynolds Aluminum, conveniently stocked by a distributor near you. Just look for Reynolds Aluminum listed in the yellow pages of your telephone directory. For more complete information, write to address below.

Corrosive fumes won't eat into these aluminum exhaust stacks, but they'd murder many another metal. Aluminum is best in industrial atmospheres.

This exhaust hood is above a tank for highly explosive solvent. Aluminum's non-sparking quality is a safety factor here.

FREE! Send for this helpful booklet on the proper use of Reynolds Aluminum for sheet metal work.



REYNOLDS METALS COMPANY, Aluminum Division, 2566 South Third Street, Louisville 1, Ky.

REYNOLDS *Lifetime* **ALUMINUM**

THE COMPLETE ALUMINUM SERVICE FROM MINE TO FINISHED PARTS

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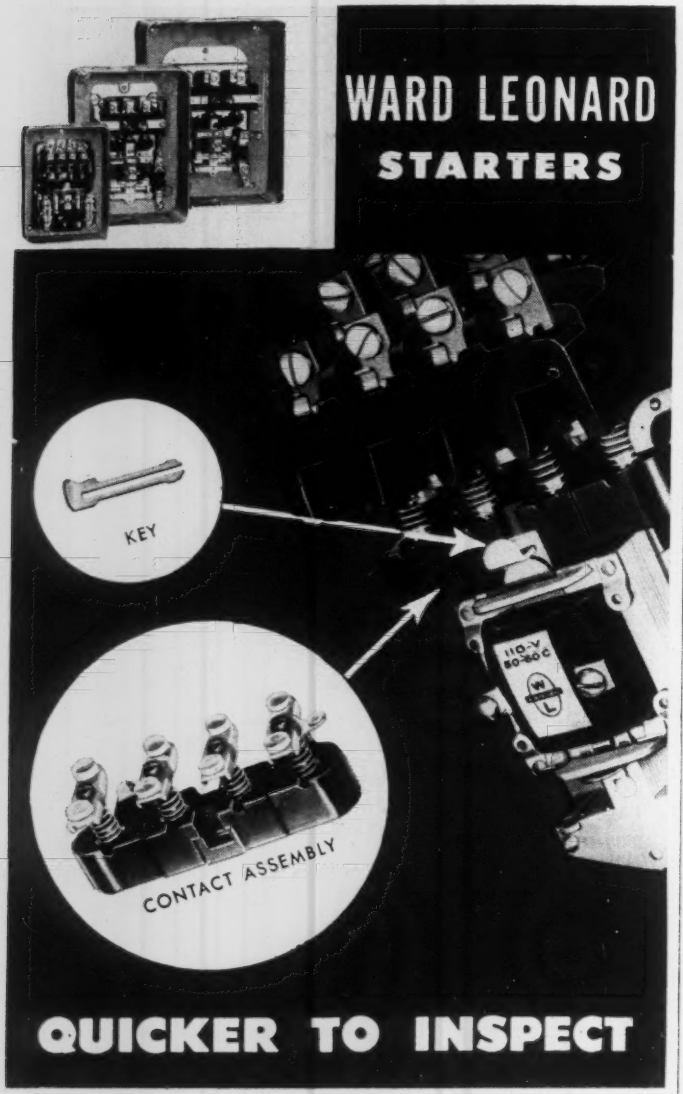


because contactor parts are ACCESSIBLE

Removing a single key permits the entire moving contact assembly to be withdrawn for inspection of all main silver contacts, both moving and stationary.

And it's easier to replace main stationary contacts, too, due to the use of individual spring retaining clips.

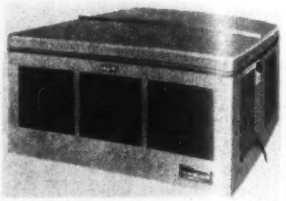
Write for Bulletin 4110. It fully describes Ward Leonard's new Size 1, 2 and 3 across-the-line, non-reversing AC magnetic starters. Ward Leonard Electric Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

Lower Prices Feature Packaged Air Conditioners

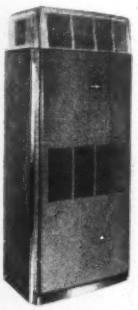


No. 4065—Frigidaire Div., General Motors Corp., Dayton 1, Ohio, has announced new packaged air conditioning and refrigeration equipment lines priced from 3 to 21 percent lower than last year.

The new prices affect 18 separate products including four completely new, redesigned self contained conditioners.

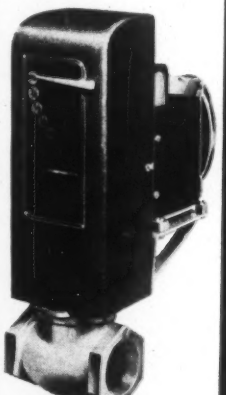
The larger of two new window units is equipped with two independent refrigerating systems for "selective cooling" and has 1 hp refrigerating capacity. The cooling operation is said to be more economical because one or both of the twin "Meter-Miser" units can be operated depending upon outside weather conditions. This unit is designed to fit double hung windows from 30 to 56 in. wide and to cool, filter, dehumidify, and circulate air at a rate of 315 cfm.

The smaller window model, equipped with a single compressor unit, is designed to fit double hung windows from 28 to 54 in. wide and will deliver up to 200 cfm of conditioned air.



The new 3 and 5 hp store air conditioning units are equipped with four-way air distribution hoods (four air discharge grilles located on the front of the distribution hood, four on the rear, and a single outlet on either end). The 5 hp model is equipped with a two cylinder compressor mounted on twin water cooled condensers connected in parallel. The receiver-condenser is said to have a low water pressure drop and separate connections for use with city water or cooling tower systems. A heating coil can be installed for winter use. Similarly equipped the 3 hp unit has a single condenser.

Valve Motor Provides Power Failure Protection



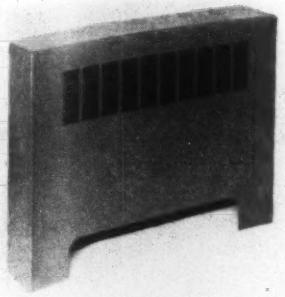
No. 4066—A new valve motor, with a return spring built-in, has been designed by Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., S., Minneapolis 8. Units are available for either normally open or normally closed slip-stem valves (maximum valve lift 1⅛ in.), and for either two position or modulating service.

Upon power interruption, or failure, a factory adjusted helical spring is used to return the valve to the closed (or open) position. These motorized valve assemblies employ spring return motors which have a full 160 deg angular stroke. This, says the company, permits maximum output torque allowing the same operating pressure ratings as assemblies using nonspring return motors with corresponding valves.

Typical applications of the normally open valve motor

are said to include preheat coils, tempering coils, zone valves for steam and hot water piping in greenhouse heating systems, etc. Typical applications of the normally closed valve motor are said to include pan type humidifiers, steam injectors, water atomizing sprays, main gas or oil valves, heavy oil systems, etc.

Copper Convectors Designed for Use with Steam, Hot Water

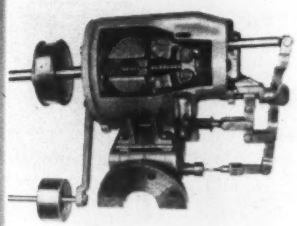


No. 4067**—The newly formed Universal Convector Corp., 230 Manida St., New York 59, is now making deliveries on a line of copper convectors for one pipe steam systems, two pipe steam, vapor, and vacuum systems, and circulating hot water systems.

Heating elements are of seamless copper tubing with mechanically bonded aluminum fins. Various cabinet styles are available for both free standing or recessed installation. Cabinets are of furniture steel and dampers are optional. The standard heating element connection is a ¾ in. pipe tap, except for units to be used with one pipe steam systems where 1¼ in. pipe taps are furnished.

Eight cabinet heights from 18 to 36 in. are furnished as standard in widths of 4, 6, 8, and 10 in. Special sizes may be ordered.

New Steam Engine Governor Achieves Wide Speed Range



No. 4068—Governor control of steam engine speeds over ranges of 2 to 1, 4 to 1, or 6 to 1 can be obtained with the new "Troy-Engberg" type EN throttling governor developed by Troy Engine & Machine Co., Troy, Pa. Engine speed can be varied either at the governor or from a remote point, manually or automatically.

The design of this governor features totally enclosed construction and self lubricating mechanism. Its horizontal shaft is said to eliminate the customary bevel gears. Ball bearings are used throughout.

Other features include automatic stop in the event of belt failure, interchangeable parts through a wide range of sizes, and adaptability to old or new steam engines of either horizontal or vertical design.

Improves Concrete, Cement Plaster, and Cement Mortar

No. 4069—"Portite," according to Hopper Products, Inc. 12 E. 41st St., New York 17, is a nontoxic liquid admixture for improving concrete, cement plaster, and cement mortar.

Described as a long chain, high molecular, neutral compound in aqueous solution, it is said to be stable, noninjurious to the skin, and can be stored in below freezing temperatures. It is shipped in liquid form and is used in the ratio of 4 oz per bag of cement.

Air Conditioned with Frick Refrigeration

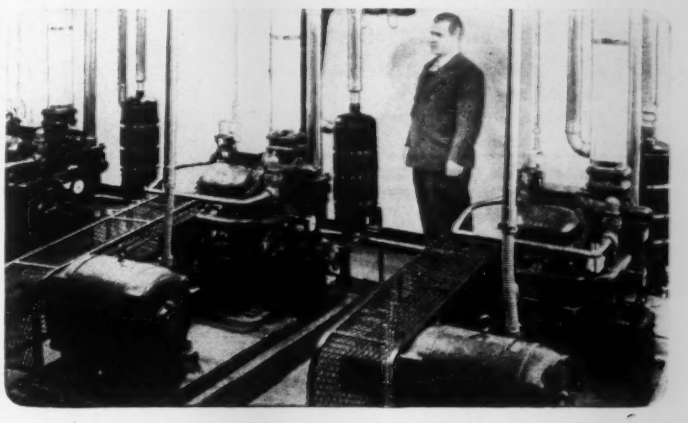
The new building of Maryland's largest broadcasting and television station, at Baltimore, is air conditioned throughout with three Frick compressors, each having four cylinders, as shown below. This fine installation won the 1948 Building Trades Award for the Paul J. Vincent Co., Baltimore Distributors for Frick Refrigerating, Ice-making and Air Conditioning Equipment.

Gloria Halliday, Popular Singer at Station WBAL

Enter your order now for the air conditioning system you need. Consider Frick NEW "ECLIPSE" compressors: for details write

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

Frick Refrigerating Machines at Radio Station WBAL



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with **FAN-PAC**

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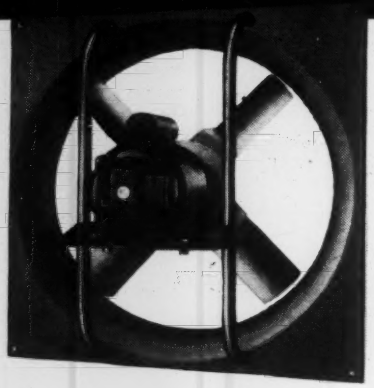
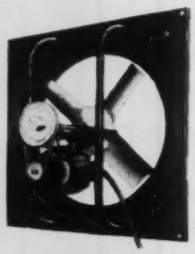
OFFICE BUILDINGS
TAVERNS



DIRECT MOTOR DRIVEN
Available in 16", 18", 20", 24" sizes.

Certified Ratings
PFMA

Here's a valuable inside tip for cool summer profits! Business establishments everywhere seek ways and means of creating increased employee efficiency during hot, sultry weather. FAN-PAC is the answer, circulating cool, fresh air for more healthful, comfortable working conditions. Increased customer traffic and new patronage is also the result of FAN-PAC easy-to-install Packaged Ventilation. Cash in on this huge market! Build a bigger summer business for yourself by investigating FAN-PAC *TODAY!*



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Available in 24", 30", 36", 42", 48" sizes.

Important FAN-PAC Features

1. Non-Overload Power Characteristic
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3. Square Panel Mounted for Easy Installation
4. Scientifically Correct Air Inlet
5. Cushioned Motor Mountings for QUIET Operation
6. Motors of Nationally Recognized Make

FREE FAN-PAC CATALOG! Send today for new catalog, complete with illustrations, specifications and capacities.

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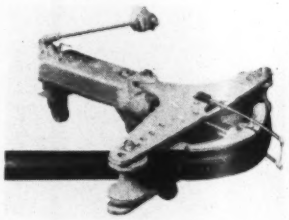
Advantages stressed by the manufacturer include control of air entrainment; reduction of water requirements bleeding, shrinkage, and finishing time; elimination of segregation; improvement of workability at low slump resistance to freeze-thaw effects; and increase in compressive strength.

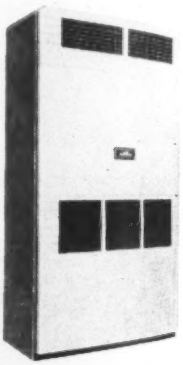
Portable Hydraulic Bender Handles 3/8 to 4 in. Pipe



No. 4070—The new 4 in. hydraulic portable pipe bender of Tal Bender, Inc., Milwaukee, is now in commercial production and is designed to handle regular and extra heavy pipe or rigid conduit from 3/8 to 4 in.

The semi-circular bending formers and the bend indicator showing degree of bend are said to make this machine foolproof. It is claimed that only 15 min is required to make 90 deg bends with 4 in. pipe. The unit is mounted on casters and can be set up for on-the-spot installation and repair. Attachment for motorizing can also be furnished.

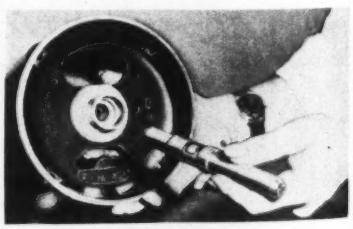
Adds New Features to Store Conditioners



No. 4071—United States Air Conditioning Corp., Como Ave., S.E., at 33rd, Minneapolis 14, has incorporated a number of improvements in its 3 and 5 ton upright store conditioners. Outstanding features, says the company, include silent, vibrationless operation, fine appearance, and efficient performance.

The USAIRco units are designed to function as complete air conditioning systems by cooling, dehumidifying, circulating, and filtering the air. Heating coils may be mounted in the plenum section.

Motor Sleeve Bearings Replaced in One Operation

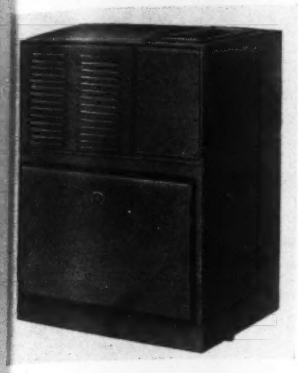


No. 4072—Worn sleeve bearings can be removed from motor endplates, and new bearings inserted in one operation with a new tool developed by Wagner Electric Corp., 6489 Plymouth Ave., St. Louis 14. The tool consists of a steel rod, accurately finished to accommodate precision bored bearings on one end, and unbored bearings (for undersize shafts) on the other. A central shoulder separates the two ends.

The new bearing is slipped on the rod, its unchamfered end against the shoulder of the tool. A spacer, furnished with the tool, is slipped on with its unchamfered end against the new bearing. The end of the tool is then inserted in the old bearing, from the inner side of the endplate. The new bearing should be positioned on the tool so that its oil wick hole lines up with the hole in the old

bearing. A press or rawhide mallet is then used to drive the tool until its shoulder seats against the endplate. The spacer forces out the old bearing, and the new bearing, as it is pushed into its proper position, forces out the spacer. The tool is available in four sizes.

Evaporative Condensers Incorporate Prime Surface Coils, Redesigned Blowers



No. 4073—New evaporative condensers, made in 3, 5, 8, and 10 ton models and designed for use with "Freon," methyl chloride, or any other common refrigerant, are offered by Typhoon Air Conditioning Co., Inc., Brooklyn, N. Y.

Said to save 95 percent of water costs, to eliminate waste water disposal, to be quiet in operation, and to require minimum space, units feature a condensing coil which is all prime surface, is constructed of continuous lengths of seamless copper tube, and is pitched to allow rapid gravity flow of condensed liquid refrigerant. This feature, says the company, is combined with a carefully planned spacing of tubes to insure even wetting and intimate scrubbing contact.

Another feature is a redesigned blower which is used to force dry air through the coil, instead of drawing moist air in. For this reason, says the manufacturer, the blower does not come in contact with high humidity air or any entrained moisture, and is not subject to danger of rusting. "Carry over" of spray in the discharged air is said to be eliminated without the use of eliminator plates. Spray nozzles are made of machined bronze castings, designed to provide a coarse spray and complete coverage of coils at low pressure.

Insulating Material Can Be Shipped as Liquid Resin

No. 4074 — Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, has developed a plastic foam, that expands to 100 times its original volume when baked, for use as a new insulating material. This development is said to be the result of a three-year search for "an effective insulating material that will fill large areas yet weigh almost nothing."

According to the company, it is lighter than some gases, is resistant to fire, moisture, fungus growth, and insects, and is practical for many applications.

The foam is made by heating a molasses-like synthetic resin at about 350 F until it expands to 100 times its original volume and then solidifies. Thousands of gas bubbles entrapped in the foam buoy it up and give the plastic lightness. The chief advantage is said to be the fact that the liquid resin can be shipped in a barrel and then foamed into place wherever needed.

PEAK PERFORMANCE!
LOWER COST!
Rittling FINNED TUBE CONVECTOR RADIATORS

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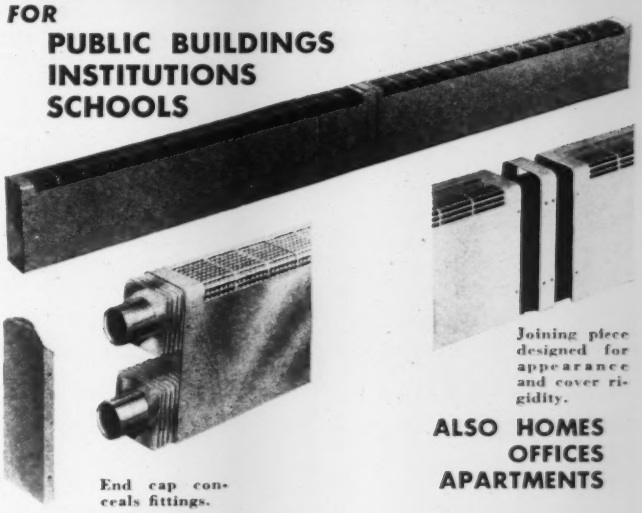

Joining piece designed for appearance and cover rigidity.

End cap conceals fittings.

ALSO HOMES
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HIGH QUALITY: High pressure seamless steel tubing with closely bonded heavy gage steel fins, solid metal perforated cover.

FULL EFFICIENCY: Two and three row convectors develop 200% and 300% of single row heating capacity, respectively.

ATTRACTIVE: Streamlined, harmonizes with interiors, easy to keep clean.

MONEY-SAVING: Low primary cost, installation and fuel costs.

MANUFACTURERS
OF FINNED TUBE
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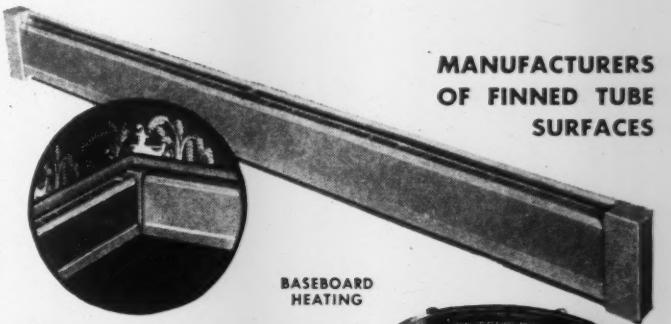
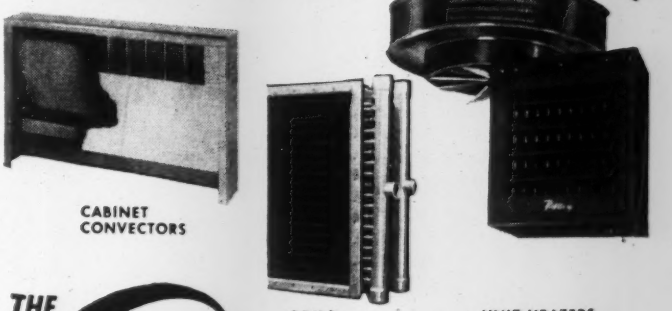


BASEBOARD HEATING



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Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

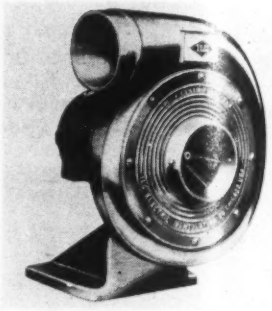
Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for Bulletin N-616.

YARNALL-WARING COMPANY
107 Mermaid Avenue Philadelphia 18, Pa.

Offers Centrifugal Fan for Many Applications

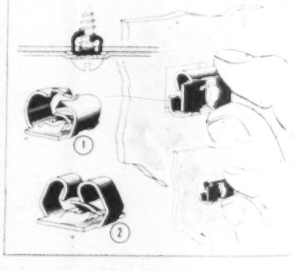


No. 4075—The type PE (pressure exhaust) centrifugal fan, recently developed by Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, is said to be suitable for air supply or exhaust at various pressures up to 12 in. SP.

Numerous applications stressed by the manufacturer include dust removal; conveyance of raw materials or waste in processing wool, cotton, paper, wood, hemp etc.; exhaust of fumes, smoke, steam, and vapors; and air supply for forges, furnaces, ovens, and drying operations. The fan housing is of one piece cast construction and the dynamically balanced wheels are of cast aluminum. Units are available in all regular NAFM discharge arrangements and the discharge can be changed by removing the side bolts and rotating the housing. Wheels are convertible for clockwise or counter clockwise rotation.

Four sizes are available with wheel diameters ranging from 7-9/16 to 21 in. Direct connected units have capacities from 164 cfm at 3½ in. SP to 4000 cfm at ½ in. SP. Capacities of belt driven fans are from 422 to 5610 cfm.

Permits Blind Assembly of Metal Panels



No. 4076—Blind assembly of parts to metal panels can be accomplished quickly and efficiently with new expansion "Speed Nuts" according to Tinnerman Products, Inc., 2035 Fulton Rd., Cleveland 13.

Designed to permit the complete assembly to be made from one side and to eliminate the necessity of two operators working on opposite sides of large panels, they are inserted into square or round holes and the part to be attached is then placed in position and the screw driven. The company's locking principle is embodied in the base. Said to be self retaining and to expand when a tapping screw is inserted, they are produced in two different basic designs, Fig. 1 having spring arms that are formed to grip at the root of the screw thread while Fig. 2 illustrates spring arms turned under to "ride" on the crest of the screw threads.

Six New Motors, Four New Small Motor Blowers Added to Line

No. 4077—Six new types of electric motors, sold under the trade name "Micromotors," and four new small motor blowers have been developed by Redmond Co., Inc., Owosso, Mich.

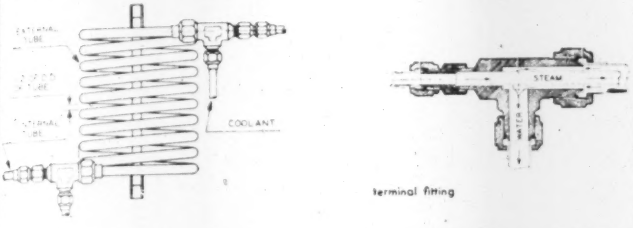
Shaded pole, a-c motors include types CU, CL, BW, BT, and BL. The types CU and CL are of the four pole type and are rated at 1/10 hp and 1/12 hp respectively, at 1550 rpm. Types BT and BL are two pole units rated at 1/30 hp and 1/40 hp at 3000 rpm respectively. Type BW

is a six pole motor said to deliver 1/20 hp at 1000 rpm. Available with series or shunt windings, the type J motor is for d-c operation at 6 to 24 volts and is rated at 1/10 hp.

Models 3866, 3802, and BL-13 are single outlet blower-motor units designed to deliver 150, 100, and 80 cfm respectively. The model 3901 unit is of the double outlet type and is rated at 220 cfm.

Dual Transfer Coils Used to Exchange Heat Between Liquids, Gases

No. 4078—Dual heat transfer coils for heat exchange between liquids and gases are now offered by Parker Appliance Co., 17325 Euclid Ave., Cleveland 12.



Used for cooling steam or water test samples on boilers of all ratings, in refrigeration equipment, in oil still and in hydraulic circuits for cooling oil, the coils are available in two ratings. For service at pressures to 1000 psi and temperatures to 700 F, the units are fabricated of seamless copper tubing and bronze fittings. Six standard sizes are available. For pressures ranging to 2000 psi and temperatures to 1500 F, the outer coils are of seamless copper, while inner coils are stainless steel. End fittings are also stainless and coil terminals are carbon steel. Three sizes are stocked.

In the standard sizes, 19½ ft of tubing is used in the outer coil, 20 ft in the inner coil. External tube size ranges from ½ to 1½ in. OD; internal tubes from ¼ to 1 in. From 5 to 13 coils are used.

Equipment Shorts

A fourth major unit for continuous production line coating of flat rolled steel in a bath of molten zinc or aluminum was put into operation last month by **Armco Steel Corp.**, Middletown, Ohio. The new unit will produce "Zincgrip" and "Aluminized" steels. In addition, the patented coating process will be offered to other steel companies under license arrangements. This, says the firm, will mean that "Paintgrip" or bonderized sheet will be available, industry wide, on the special zinc base. . . . Price reductions ranging from 3 to 14 percent on standard sump pump motors, oil burner motors, belt drive fan motors, and certain horsepower ratings of standard jet pump motors have been made by **General Electric Co.'s** fractional horsepower motor divisions, Schenectady, N. Y. The reductions are said to be the result of cost improvements from standardization in these definite purpose motor lines and do not represent a general price change.

Ward Leonard Electric Co. has moved its general office, including executive and sales offices, to a new building at 115 S. MacQuesten Parkway, Mount Vernon, N. Y. . . . **Marley Co., Inc.**, Kansas City, Kans., has started production in its new Louisville, Ky., plant which will be used primarily for fabricating metal for the company's products but will also be used for assembling some of its smaller units. Several models of nozzles, cooling towers, and dry

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NO-VISION GRILLES
for Doors, Walls and Partitions

...BUT YOU CAN SEE
Extra Profit Opportunities with the Complete Line of Independent Registers and Grilles

Where ventilation without vision is desired—in doors, walls and partitions—Independent No-Vision Grilles meet every requirement. It's impossible to see through an Independent No-Vision Grille from any viewpoint.

Independent No-Vision Grilles are made in two styles—Style C, with grille core only, installed with molding as shown above; Style R, with overlapping rim on all four sides of one surface of the grille, as illustrated at the left.

Independent No-Vision Grilles are made in 46 standard sizes, for openings from 8"x 6" to 30"x 24", and additional sizes can be furnished.

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Write for new Catalog No. 48—gives schedules of sizes, details and prices of registers and grilles for every purpose.

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THE INDEPENDENT REGISTER CO.
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surface coolers will be carried in stock. . . . A 22 percent reduction in the price of "Santocel," a silica aerogel used for refrigeration and industrial insulation, has been announced by **Monsanto Chemical Co.,** St. Louis, Mo. The reduction is said to result from increased production.

One of the first experimental gas turbines specifically designed for installation in gas pipe line service will be built for **Tennessee Gas Transmission Co.** jointly by **Clark Bros. Co., Inc.,** Olean, N. Y. (one of the Dresser Industries) and **Frederic Flader, Inc.,** North Tonawanda, N. Y. With an expected thermal efficiency of more than 30 percent, the gas fired turbine will develop 5500 hp to drive a centrifugal compressor. Primary purpose of the installation is to test the feasibility of gas turbines as prime movers for long distance transmission of natural gas. . . . **Westinghouse Electric Corp.** has launched full scale manufacturing and repair operations at its recently completed plant at 3900 W. 41st St., Chicago. Said to be the largest electrical repair plant in the midwest, it will be used for all types of repairs on industrial apparatus. Equipment to be manufactured in the plant includes switchgear, industrial control, control centers, and lighting and power panels.

Koppers Co., Inc., Pittsburgh, has purchased **Freyn Engineering Co.,** a Chicago firm specializing in design and construction of blast furnaces and open hearth furnaces, and in the engineering of mills, power stations, and other steel mill facilities. The acquisition also includes **Open Hearth Combustion Co.,** a Freyn subsidiary. Freyn will continue under its present name, and for the time being will be operated as a wholly owned subsidiary of Koppers with no changes in policies or personnel. . . . **Research Corp.,** New York City, is building a new plant near Bound Brook, N. J., for the manufacture of electrical precipitators for removing dust, fumes, and mists from industrial gases and from the atmosphere. Engineers and architects for the new plant are **Giffels & Vallet Inc.** and **L. Rossetti,** Detroit.

Price reductions ranging from $30 to $65 on three of its room air conditioner models have been effected by **Remington Air Conditioning Div., Remington Corp.,** Cortland, N. Y. According to the firm, they are made possible by "increased productivity of labor, some reduction in the cost of materials, and the fact that domestic orders for the first quarter of this year were well over double those for the same period last year." . . . A new sound motion picture in full color and with a running time of 32 min tells the story of "Transite" pipe for underground water systems. It is available for group showings from **Johns-Manville,** 22 E. 40th St., New York 16.

Centrifugal compressors manufactured by **Westinghouse Electric Corp.,** Pittsburgh, will be used to cool the atomic pile under construction at the **Brookhaven National Laboratory,** Upton, N. Y. The units, which have already been shipped from the company's Sturtevant division, are of the double inlet type and are driven by 1500 hp motors at 450 rpm. Each of the 12 ft high air movers incorporates a 3½ ft diameter, nine bladed, all-steel wheel. . . . **Morton-Gregory Corp.,** Toledo, has sold

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Aerofin Corporation, through its home office and nine strategically located branch offices, is prepared to help you on all problems involving the application of Aerofin heat exchange surface or to suggest the most efficient use of this superior surface to a variety of requirements.

The prompt, personal and technical cooperation of our engineers is at your disposal. Write to the home office in Syracuse or consult your local telephone directory for addresses of branch offices listed.

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LUMINOUS FLAME MODEL

Easy to install. Operates manually or automatically. Burns clean fuel—natural, mixed, manufactured or LP gases—without soot or smoke. Luminous flame radiates heat two to three times faster than a blue flame. Four sizes available for either vertical or horizontal firing.

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Designed to meet the requirements of this type of burner. Capacity range of 100,000 to 200,000 Btu/hr. for operation on natural, mixed or manufactured gases. Manual or automatic operation. Easy to install.

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Want to install automatic regulating valves and know they're right . . . now and in the future . . . ? For trouble-free operation that makes your good job better, specify and make sure you get KLIPFEL Automatic Regulating Valves, designed to give more consistent service, longer and with less maintenance.

Bulletin No. 146 describes the many KLIPFEL Valves used in heating, piping and air conditioning. Write Dept. F-6. for your free copy.

Float Valves, Reducing Valves, Tank Thermostats and Back Pressure Valves
Sold through wholesalers everywhere.

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the American manufacturing and sales rights of the "Co-Z-Air" portable electric radiator to **Conco Engineering Works,** Mendota, Ill. . . . **Parker-Kalon Corp.,** New York City, has made a price reduction of approximately 11 percent on all types of its slotted head, hardened self tapping screws used for metal fastenings. Also reduced in price are hardened screw nails, used to fasten metal to wood. The reductions covering both bulk and packaged quantities, restore prices to the January 1947 level.

C. A. Dunham Co. has moved its general offices to the new one story addition of its Michigan City, Ind., plant. Part of the new building is being used for the storage of finished products and the balance houses the order and billing departments, formerly in Chicago. Administrative offices remain in Chicago. . . . The R-P "Alumaloy" air filters of **Research Products Corp.,** Madison, Wis., are now listed by the Underwriters' Laboratories. The listing includes Class I on dry filters and Class II on the adhesive treated type. The filter medium is multiple layers of expanded aluminum alloy sheets.

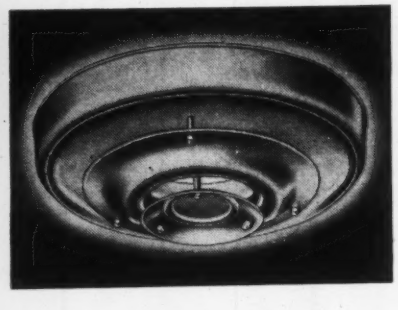
Central Steel and Wire Co., P. O. Box 5310-A, Chicago 80, is the midwest distributor of aluminum fasteners manufactured by Aluminum Company of America. Screws, machine bolts, nuts, washers, and nails are among the many items available for immediate delivery. . . . The "Torchmaster" is a general utility, self contained hand torch, 2¼ x 13 in., which burns liquefied petroleum gas. It is said to hold enough fuel for an average day's burning and may be filled from standard containers for from 3 to 5 cents. It is designed for light brazing, soldering, and many heating applications. The manufacturer is **Industrial Engineered Products Co.,** 7416 Melrose Ave., Los Angeles 46.

A curtain wall of cellular glass and concrete is now available and, according to **Pittsburgh Corning Corp.,** 632 Duquesne Way, Pittsburgh 22, has superior characteristics, economic advantages, and is readily adaptable to any design requirement. Used in buildings erected within the past two years, the panel consists of "Foamglas" cellular glass insulation cores and concrete veneers made up into thin flat sandwich walls. The popular thickness is said to be 6 in.; a 2 in. cellular glass core with 2 in. exterior and 2 in. interior veneers. The concrete veneers are processed by heavy mechanical troweling, steam curing, and by vacuum processing. Walls have been fabricated in several sizes for use in all three basic curtain wall systems, spandrel, vertical, and bay-filling.

Hydraulic dynamometers, designed, built, and used by **Wagner Electric Corp.,** 6488 Plymouth Ave., St. Louis 14, are now available to motor repair shops and other establishments where accurate load testing of motors is an important operation. . . . A new welding helmet with a movable "Blinker" lens is designed to permit the operator to lower and raise the filter lens (without raising the helmet) by a downward or upward movement of his chin against a pivoted chin strap. This, says **Welders' Products Co.,** 141 W. Jackson Blvd., Chicago 4, leaves both hands free at all times.

Type "RE" FUSEAIR ◀
Type "SE" FUSEAIR ▶

NO DIRTY CEILINGS WITH *fuseair*



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● The problem of ceiling discoloration has been effectively minimized by the development of Type "SE" FUSEAIR. The extended moulding design-feature of this unit will assure your customers a tremendous saving in redecorating costs.

ALADDIN HEATING CORPORATION

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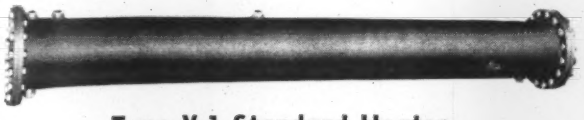
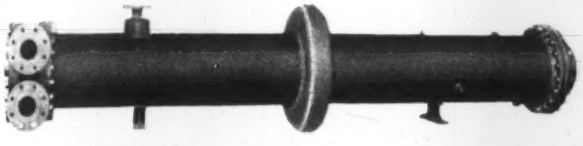
WHICH OF THESE
WHITLOCK FUEL OIL HEATERS
DO YOU NEED?

You can reduce pumping costs and assure more effective combustion by preheating the heavier fuel oils with these Whitlock Heaters. They are available in a complete range of sizes and types to provide the optimum viscosities for your particular operating conditions.



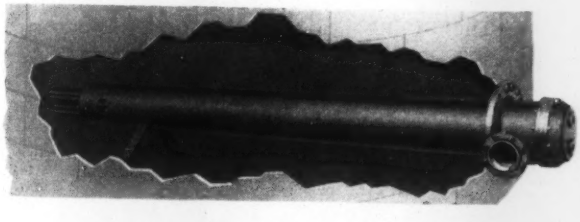
Type V-1 Standard Heater

This popular heater is low in cost, simple in design. Made with straight tube bundle having a rolled steel tube sheet welded to shell, minimizing the number of joints. Type V-1 is designed for easy mechanical cleaning without breaking any line connections. Four standard sizes cover most industrial requirements.



Type W Heater for High Temperatures

To compensate for differential expansion or contraction between shell and tubes, Type W incorporates a special Whitlock fabricated expansion member. Straight tubes allow easy mechanical cleaning. Standard sizes are designed for working pressures of 250 p.s.i. or 400 p.s.i. on both shell and tube side, but can be supplied for elevated oil and steam pressures when required.



Suction Type Fuel Oil Heater

These heaters facilitate pumping from large storage tanks by heating oil for easy removal. Since oil is heated only as it is drawn off it is not necessary to heat entire contents of tank. Heating section is of U-bend type steel tubing. Unit can be readily welded, riveted or bolted to storage tank as required.

Write for Bulletin 35

The Whitlock Manufacturing Co.

44 South St., Elmwood, Hartford 2, Conn.

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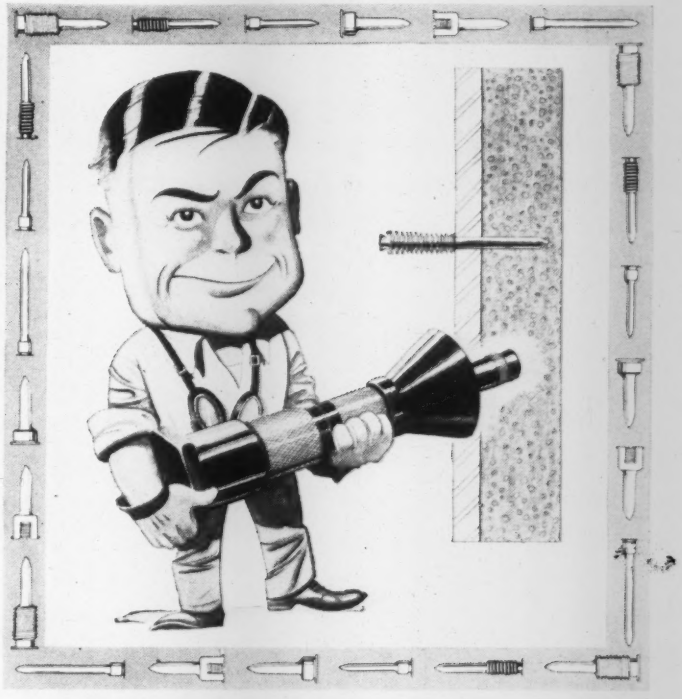
WHITLOCK HEAT TRANSFER EQUIPMENT



"Fastens quicker than lightning" says JOE RAMSETTER

Slash fastening time and costs — set steel pins and studs instantly into steel or concrete with RAMSET SYSTEM

In 30 seconds, from start to finish, you can "nail" wood, steel and other hard materials to steel or concrete. You can set threaded studs for an endless variety of fastening jobs.

Cut costs! Users show savings up to 60% in time and materials over old-fashioned methods.

Save time! Get your work finished amazingly faster. Avoid costly delays caused by time-consuming drilling and plugging.

Easy to use! Light, compact RAMSET TOOL requires no electric or air lines — it's self-powered. Any good workman can learn "Ramsetting" in 30 minutes — and can set up to 50 fastenings in an hour.

Get details! Ask for 15-minute demonstration of how RAMSET SYSTEM can save you time and money — get your work completed faster, more profitably. Use the coupon.

Stemco Corporation, Cleveland 16 (Rocky River), Ohio. In Canada — Globe Machine Tools, Batawa, Ontario.

Ramset
FASTENING SYSTEM

HP-6

Stemco Corporation,
Cleveland 16 (Rocky River), Ohio

Please send details and arrange 15-minute demonstration of RAMSET FASTENING SYSTEM. No obligation, of course.

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Water Tight,
Air Tight,
Corrosion-Proof
Gasketing Procedures

WITH
Chrome Lock

ADHESIVE
BACK,
CHROMATE
IMPREGNATED

FELT TAPES

STAMPINGS

CORROSION PROOF, WATER & AIR TIGHT JOINTS

Chrome Lock is a specially compounded and impregnated felt, containing zinc chromate as a corrosion inhibitor. It is widely used for flange gasketing in forced air systems, moisture sealing in spray cooling units, flue sealing and many similar installations.

Check through these advantages and see how Chrome Lock can solve many of *your* sealing problems, too!

LESS APPLICATION MAN HOURS: Chrome Lock's pressure sensitive adhesive back holds it in place, even on vertical or inverted surfaces. No tying, taping or cleanup. One-man operation. No odors. Non toxic.

LOWER COSTS: Actual cost comparisons of completed jobs, labor and materials considered, show savings up to 50% when Chrome Lock is used.

LONGER GASKET LIFE: Chrome Lock's continued pliability and distortion resistance assure a positive seal for the life of the installation.

PREVENTS CORROSION: Chrome Lock extrudes sufficient resins onto the faying surfaces and, being non-oxidizing, holds the metal in a passive state.

Inhibits electrolytic action between dissimilar metals. • Permits lighter flanging materials. • Anti-wicking. • Non-soluble in water or saline solutions. • Permits the use of raw sheet stock for flanges. • Protective cushion against vibration and shocks. • Will not support combustion. (Type N, Navy Spec. 33F8.) • Wide range of heat, cold and pressure resistances. • Available in rolls, tapes or stamped; 3/16" to 72" wide, 1/32" to 1/4" thick.

FREE! ***Write on your company letterhead, for engineering folder, No. CL-1023 and free sample, now!***

PRODUCTS RESEARCH COMPANY

5426 San Fernando Road • Glendale, Calif.

WHO'S WHAT

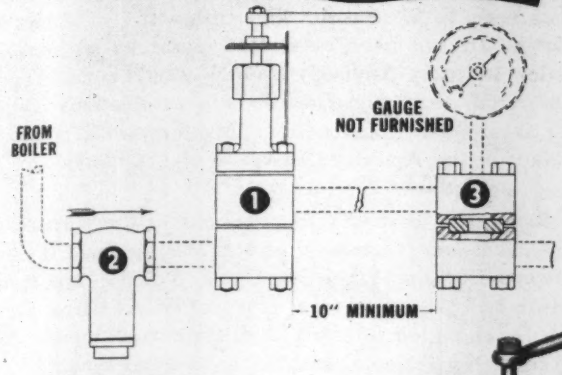
Charles E. Wilson and **Philip D. Reed** have been re-elected president and chairman of the board respectively of **General Electric Co.**, Schenectady, N. Y. All other officers have also been re-elected and **Ralph J. Cordiner**, vice president and assistant to the president since 1945, is a new executive vice president and a director of the company. **L. E. Thompson** is now manager of product service and renewal parts sales for the company's air conditioning department . . . **Dr. Willis H. Carrier**, chairman emeritus of Carrier Corp., was recently honored at a testimonial dinner by the North American branch of the **Newcomen Society** of England as the "father of air conditioning." Newcomen is an honorary society which honors persons who have contributed to the material progress of mankind.

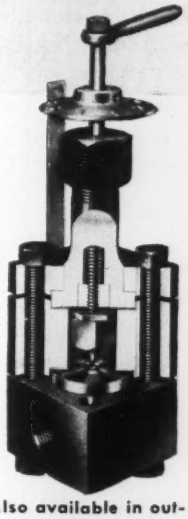
At the recent shareholders' annual meeting, all directors of **Crane Co.**, Chicago, were re-elected. **Harry F. Potter**, who has been with the company for almost 50 years and has been secretary since 1943, has retired. **Paul Yates**, who has been on special assignment with Crane Ltd. of Great Britain, is the new secretary . . . The **New York State Society of Professional Engineers** has elected **George J. Nicastro** president. He is a sales engineer with Combustion Engineering-Superheater, Inc., New York, has been active in the national society as vice president, and is a past president of the New York chapter. . . . **James N. Livermore** is now in charge of the mechanical division of construction engineering, **The Detroit Edison Co.** Prior to his recent promotion he had been acting supervisor of the division. In 1929 he became group leader responsible for the design of air conditioning, ventilation and refrigeration systems.

Lew E. Wallace has become general manager of sales and **Jay W. Owings** is a new assistant general manager of sales for **Youngstown Sheet and Tube Co.**, Youngstown, Ohio. For the last 16 years Mr. Wallace has been manager of the company's New York sales office. He fills the vacancy created by the death of **Charles H. Longfield**. In his new position he will have two assistants, **Myron H. Watkins**, who has been assistant general manager of sales for two years, and Mr. Owings, formerly manager of oil country tubular sales . . . **Permanente Products Co.**, sales affiliate of Permanente Metals Corp., has opened a sales office in the Boston Safe Deposit and Trust Co. building to serve the New England area. **Robert E. Belknap, Jr.**, formerly president of Griffin-Belknap Co., Inc., is in charge.

John Everetts, Jr. has resigned his affiliation with the consulting engineering firm of Urdahl and Everetts and is now associated with **Charles S. Leopold**, consulting engineer of Philadelphia. Mr. Everetts is the author of a number of articles published in HPAC . . . **Joe Wheeler, Jr.**, is now managing the New York office of **Johnson Service Co.**, Milwaukee. He has been with the firm since 1931 and in the New York office since 1935. The company has recently opened two New England branch offices. Under the management of **E. J. Hoaglund**, the Hartford, Conn., branch will serve western Massachusetts and most

Custom-Built... CONTINUOUS BLOWDOWN





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STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!

Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte* Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized for *your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.

Strong Evrtyte steel valves have special Anum-Metl X† seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 68 and our Continuous Blowdown Check-Chart today!

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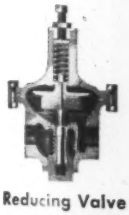

Reducing Valve

No. 80 Series Trap

Strainer

STRONG

KRITZER

NEW! RADIANT BASEBOARD

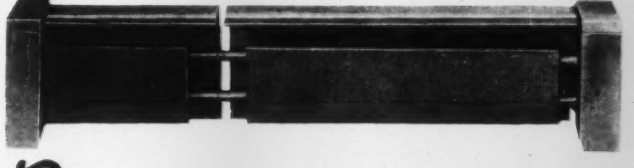
with simplified installation—

ONLY THREE EASY STEPS

for a complete job!

1 Simply place steel back-plate on the finished floor level and nail or screw to wall. Felt sealing strips compensate for uneven walls. Delivered in 10-foot lengths for quick, easy handling.

2 Back-plates secured, now snap in coil, (screw driver is only tool needed). Solder ends of copper supply. KRITZER Radiant Baseboards can be rapidly and simply cut down "on-the-spot" from the 10-foot lengths, to fit any size room.



3 Attach filler plates where required and job is complete. NOTE: for additional decoration, Grilles, also furnished in 10-foot lengths, can be added. *They are not needed for a complete job.*

CAN YOU THINK OF ANY EASIER WAY TO GET YOUR B.T.U.'s?

A KRITZER Radiant Baseboard is a permanent installation that requires nothing more—no call-backs—no extras.

Start today to make heating jobs easier the KRITZER way.

USE THE COUPON BELOW FOR COMPLETE DETAILS—DON'T WAIT.

KRITZER RADIANT COILS, INC.
2905 Lawrence Avenue, Chicago 25, Illinois

Gentlemen: I'm interested. Send at once, booklet on estimating jobs with KRITZER Radiant Baseboards.

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A Complete Unit for a Complete job

You're always *sure* you're getting the very best in efficient, economical packaged air conditioning when you specify Governair—the original patented design!

This complete unit is easy to install—requires only simple electrical, water and duct connections. Built-in Evaporative Condenser keeps water usage down to a minimum. Governair engineering assures correct coordination and balance of all functions. Generously proportioned heat transfer surfaces provide maximum performance and economy.

Choose Governair completely packaged air conditioners and you'll *always* do your best!

GOVERNAIR

ARCHITECTS • ENGINEERS • CONTRACTORS

Would you like to know how Air Conditioning jobs can be installed for from $100.00 to $400.00 per ton less?

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GOVERNAIR CORPORATION
513 N. Blackwelder • Oklahoma City, Okla.

of Connecticut and Vermont. The Portland, Me., office in charge of **E. C. Doyle** will serve that state. Both men were formerly sales engineers in the Boston office.

John W. Humphrey, formerly executive vice president of **Philip Carey Mfg. Co.,** Cincinnati, has been elected president, succeeding **Robert S. King** who is now chairman of the board. Mr. King has succeeded **George A. Rentschler** who continues as chairman of the executive committee. **L. W. Clarke,** formerly general sales manager, is the newly elected vice president in charge of sales. He succeeds **E. W. Smith,** who resigned . . . **James R. Edmunds, Jr.,** has been re-elected chairman of the **Construction Industry Advisory Council** which is made up of 107 national professional and trade associations with a major interest in construction. Mr. Edmunds is a past president of the American Institute of Architects.

L. R. Kessler is now vice president of the corporation and general sales manager of the Pacific coast division of **Owens-Corning Fiberglas Corp.,** Toledo. His headquarters will be at the new plant in Santa Clara, Calif., which is scheduled to start production next month. **Ben S. Wright** has been appointed a vice president of the corporation and general sales manager, with headquarters at the general offices. **E. W. Smith,** formerly vice president for sales, Philip Carey Mfg. Co., has been appointed special assistant to Mr. Wright. **W. C. Winterhalter** is now vice president and sales manager of the Pacific coast division, located in Los Angeles . . . **Standard Brass & Mfg. Co.,** Beaumont, Tex., is the new exclusive representative in the gulf states for **Baltimore Aircoil Co., Inc.,** Baltimore.

Cutler-Hammer, Inc., Milwaukee, has named **J. C. Atkins** to the newly created post of heating industry specialist. His duties will involve surveying the overall requirements of industry and making recommendations pertaining to electric heating. He has been associated with the firm's electric heating devices for a number of years . . . **Baker Refrigeration Corp.,** South Windham, Me., has appointed **Birmingham Gas Heating and Air Conditioning Co.** and **Flint Refrigeration Co., Inc.,** as a dual distributorship for the northern half of Alabama. The Birmingham organization will emphasize air conditioning installations and the Flint firm will handle refrigeration applications . . . **Carter B. Hart,** former sales representative in the Boston district office of **Allis-Chalmers Mfg. Co.,** Milwaukee, is now New England regional dealer supervisor. He has been with the company since 1945 and has specialized in electronics. The firm's New England region embraces offices in Boston, New Haven, Conn., and Providence, R. I.

Frank B. Moran has been promoted from assistant superintendent to superintendent of industrial relations of the Etna, Pa., plant of **Spang-Chalfant Div., National Supply Co.,** Pittsburgh. A new activity of the department, that of community relations, is being supervised by **A. D. Cadenhead,** former superintendent . . . As manager of the radiant baseboard division of **United States Radiator Corp.,** Detroit, **R. G. Kollar** is in charge of sales, production, and engineering of the firm's baseboard units. He formerly represented Trundle Engineering Co., management engineers, in the Michigan area . . . **Conway B.**

NOTE: *this message will interest plant and consulting engineers who know that an air-conditionig system is no better than the pumps employed!*

where EFFICIENCY! . . . ECONOMY! . . . and DEPENDABILITY! . . . count!

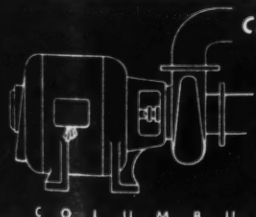
A WEINMAN PUMP IS THE HEART OF THE AIR-CONDITIONING SYSTEM!

What greater proof of quality can any pump offer than its on-the-job performance record? . . . and the WEINMAN pump record for day in and day out *Dependability! . . . Efficiency! . . .* and *Economy! . . .* as the heart of countless air-conditioning systems, is a record to convince you that *Weinman Pumps Are "Right" For The Job . . .* made right by centrifugal specialists who know air-conditioning pump requirements.

WEINMAN
TYPE "G" UNIPUMP

Especially adapted for circulation of chilled water or brine. Sizes to provide capacities of 10 G.P.M. to 1000 G.P.M., heads to 500 ft., and motor ratings ranging from ½ hp. to 30 hp.

CENTRIFUGAL SPECIALISTS



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PUMP MFG. Company

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KINETIC

A New Webster

GAS BURNER

- Designed for LOW GAS PRESSURE.
- Will Operate at ONE POUND.
- Will TURN DOWN to ½" Water.
- Fires a SCOTCH MARINE BOILER without a dutch oven or refractory lining.
- Will operate through a FIRE DOOR.
- Will NOT VIBRATE.
- Draft Loss VERY LOW.
- This Gas Burner is available in ANY SHAPE and SIZE.

Webster combustion installations are engineered from blueprints to operation.

For KINETIC BURNER Information Write—

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DIVISION OF
SURFACE COMBUSTION CORP.
Toledo, Ohio

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Briscoe, of the Queeny plant engineering staff of **Monsanto Chemical Co.,** St. Louis, has been appointed director of public utilities for the city of St. Louis. He is on leave of absence from Monsanto . . . **C. G. Walter,** who has been active in air conditioning and commercial refrigeration in southern California and Arizona for the last 17 years, has joined **Curtis Refrigerating Machine Div., Curtis Mfg. Co.,** St. Louis, as manufacturers' representative in the southwest. His headquarters are 5060 Ambrose Ave., Hollywood 27. A stock of most of the company's equipment will be maintained in Los Angeles.

Perfex Corp., Milwaukee, has promoted **Douglas L. De Vos** to Chicago regional manager of its controls division. He has been a sales engineer in the Cleveland and Detroit offices. **B. F. Werb** is now west coast regional manager and is located in San Francisco. He is a veteran of 24 years in the heating field. **E. W. Wiese** has taken over the franchising of service distributors for the controls division, previously handled by Mr. Werb. Identified in the heating industry for many years, Mr. Wiese joined the company in 1945 . . . **Thomas G. Estep,** professor of mechanical engineering at Carnegie Institute of Technology, has been made a fellow of the **American Society of Mechanical Engineers.** A fellowship is the highest rank in the society and is an honorary title.

Directors of **C. A. Dunham Co.,** Chicago, recently re-elected are: **L. P. Dwyer,** president Dwyer Products Corp.; **E. G. Bremner,** president, Bremner Biscuit Co.; **H. H. Wright,** president, H. H. Wright Co.; **H. S. Marshall** and **F. E. Schmidt,** president and vice president of Dunham, respectively. New board members are **L. D. Mancell** and **Lewis C. Murtaugh,** respectively vice president and secretary of the firm . . . **Baker Refrigeration Corp.** South Windham, Me., has appointed **Sheet Metal Fabricators, Inc.,** 1700 Friendship St., Baltimore 18, its new distributor in Maryland. The former distributor for this territory, **Air Conditioning, Inc.,** has moved its headquarters to Washington, D. C., and will continue to serve that city and the adjacent counties of Maryland and Virginia.

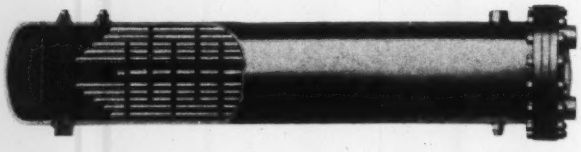
James W. Hepburn is now assistant manager of the vertical turbine pump division of **Worthington Pump and Machinery Corp.,** Harrison, N. J. With headquarters at the company's Denver works, he is in charge of sales in the territories west of the Mississippi, including Chicago, St. Paul, and New Orleans . . . Directors of **Pyle-National Co.,** Chicago, have elected **Thomas J. Little** vice president in charge of the eastern division. He succeeds **A. N. Martin,** recently retired. Mr. Little joined the company last year and was previously with the Anaconda organization in several capacities.

Pittsburgh Lectrodryer Corp., Pittsburgh, has appointed two new sales agents. **Kerr Machinery Co.,** Kerr Bldg., E. Fort and Beaubien Sts., Detroit, and **G. Baillie Houliston,** 707 Race St., Cincinnati 2, will act as exclusive agents in the Detroit and southern Ohio areas respectively. Mr. Houliston has represented manufacturers of mechanical equipment for the past 40 years. Associated with him is **Carson D. Weaver,** a former officer with the air condi-

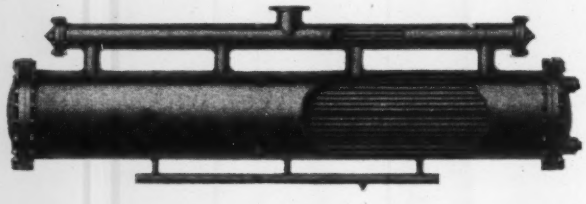
For Your Refrigeration Requirements...

WATER COOLERS

WATER COOLERS
FUEL OIL HEATERS
FREON CONDENSERS
EVAPORATORS
PIPE COILS
HIGH FIN TUBING
LOW FIN TUBING
AMMONIA CONDENSERS
RADIANT HEATING COILS
UNIT COOLERS



U-TUBE DRY EXPANDED



STRAIGHT TUBE—FLOODED

WRITE FOR D & R CATALOG, SECTION 2

EXPERIENCED HANDS ARE AT YOUR DISPOSAL FOR PRODUCING ALL TYPES OF HEAT TRANSFER EQUIPMENT.

SUPERIOR DESIGN AND CONSTRUCTION ASSURE YEARS OF SATISFACTORY SERVICE.

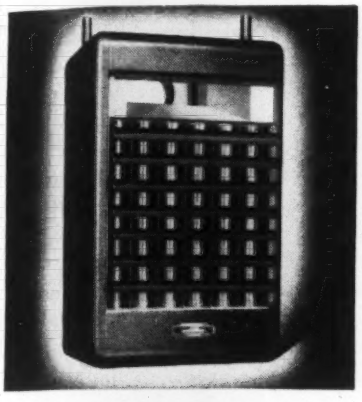
WE SOLICIT YOUR INQUIRIES.

PLANT
FOOT OF HAWKINS ST.
AT C. R. R. OF N. J.
NEWARK 5, N. J.

FOR HEAT EXCHANGE EQUIPMENT
DOYLE & ROTH MFG. CO.
ENGINEERS ▲ DESIGNERS ▲ FABRICATORS

OFFICES
10-15 49th AVE.
LONG ISLAND CITY 1,
NEW YORK

They all love the man who SAVES THEM MONEY!



● You always have a warm spot in your heart for the man who steers you onto a good thing or keeps you from making a bad deal. And your customers like you because you've been able to give them the kind of heating and air conditioning equipment and service that keeps their costs down.

That's why you're a natural to do a good job on USAIRCO's new Unit Heater. It's got what you need to protect your reputation for handling only the best equipment . . . it's got what your friends want in efficient, economical performance . . . and it's got a bargain price tag on it!

Notice the features we've built into this new unit heater. See if it doesn't measure up to all you and your customers expect from units that cost a lot more.

The unit has A.G.A. approval.

Read 'em and Reap

Ribbon type burners won't burn out. Instantly removable for cleaning. Noiseless ignition and extinguishing . . . no dangerous flash-back.

All-steel heat exchangers transfer heat quickly, efficiently . . . make economical use of fuel.

Low speed fan with broad kidney blades delivers maximum air without noticeable noise. Smoothly curved venturi assures quiet air flow.

Air is distributed uniformly without drafts by adjustable louvers of scientifically correct size and design.

Built-in draft hood allows unit to be installed within six inches of the ceiling and offsets downdrafts or results of flue clogging.

Completely automatic controls regulate running time and gas pressure, shut off unit in case of fan trouble, cut gas supply if pilot fails.

Maintenance is easy. All parts are easy to get at. Exchangers are cleaned without disturbing installation. Burners lift out.

All-steel assembly carries load of unit on hangers. Cabinet carries no stress. Tough, textured enamel finish.

Special models are available for duct installation and to take centrifugal blower in place of fan.

Models are available with steel or cast iron heat exchangers in range of sizes from *60,000* to *270,000* BTU output.

Distributor and Dealer Franchises are available. For details write to United States Air Conditioning Corporation.

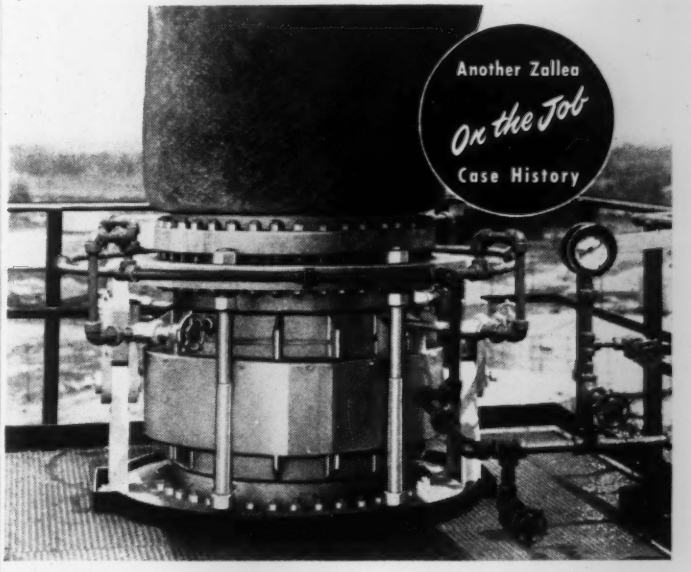
UNITED STATES AIR CONDITIONING CORPORATION
3316 Como Ave. S.E., Minneapolis 14, Minn.

Please send me more information on your Gas Fired Unit Heaters.

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



Expansion Joints Without Anchors

PICTURED ABOVE is one of two 34" diameter Zallea Stainless Steel *Hinged* Expansion Joints, among several installed in the U.O.P. designed cat cracker at a large midwestern refinery. Located more than 150 feet above the ground these two 34" Zallea joints absorb 8½" movement of the piping between the reactor and stripper, operating at 1150°F.

Whereas most types of expansion joints use guides and anchors and usually compensate for axial movement only—2 or 3 of these Zallea Stainless Steel *Hinged* Expansion Joints, spaced a given distance apart absorb all the axial and lateral movement of any system of piping in one plane. Self-supporting at all times, each joint bends angularly giving the same effect as a hinge at each elbow. This action reduces bending stresses in the piping and eliminates cumbersome anchors and supports.

In similar jobs in other refineries . . . wherever there is a need for simplified piping . . . Zallea Stainless Steel *Hinged* Expansion Joints are used, many in service since 1940. Each Zallea Stainless Steel *Hinged* Expansion Joint is designed for a specific job—designed after a thorough study of the piping problems involved. On special order, they are available in sizes up to 72" diameter and 1000 pounds pressure, as well as for temperatures up to 1600°F.

For information on the complete line of Zallea Expansion Joints—send today for Catalog 47. ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Delaware.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

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"Simplified Physics of Thermal Insulation."

AN AUTHORITATIVE, 32-PAGE BOOKLET

THE author, Alexander Schwartz, adds to his own findings those of an impressive list of experts and laboratories. The subject headings include: Heat Transfer; Conduction and Density; Convection; Radiation and Emissivity; Rejection, Reflection and Absorption. Other topics are Vapor, Vapor Barriers, Humidity, and Condensation. Every kind of material, mass fibrous insulations and reflective types, how and where to use them, is discussed. There is an enlightening exposition of thermal factors, what they mean, and how different substances compare.

THE famous "Chart of Thermal Insulation Values," a feature popular in previous editions, has been revised and amplified. It contains specially compiled information on *k*, C, R and U factors of all insulations, of all thicknesses, their densities, weights, cubic contents, etc., nowhere else grouped in so convenient form.

INFRA C FACTORS & ROCKWOOL EQUIVALENTS

C.052 Heat Flow Down, equals 6" Rockwool.
C.083 Heat Flow Up, equals 4" Rockwool.
C.10 Lateral Heat, equals 3-1/3" Rockwool.

Thermal Factors Printed on Every Infra Carton

ACCORDION MULTIPLE ALUMINUM & TRIANGULAR REFLECTIVE AIR CELLS

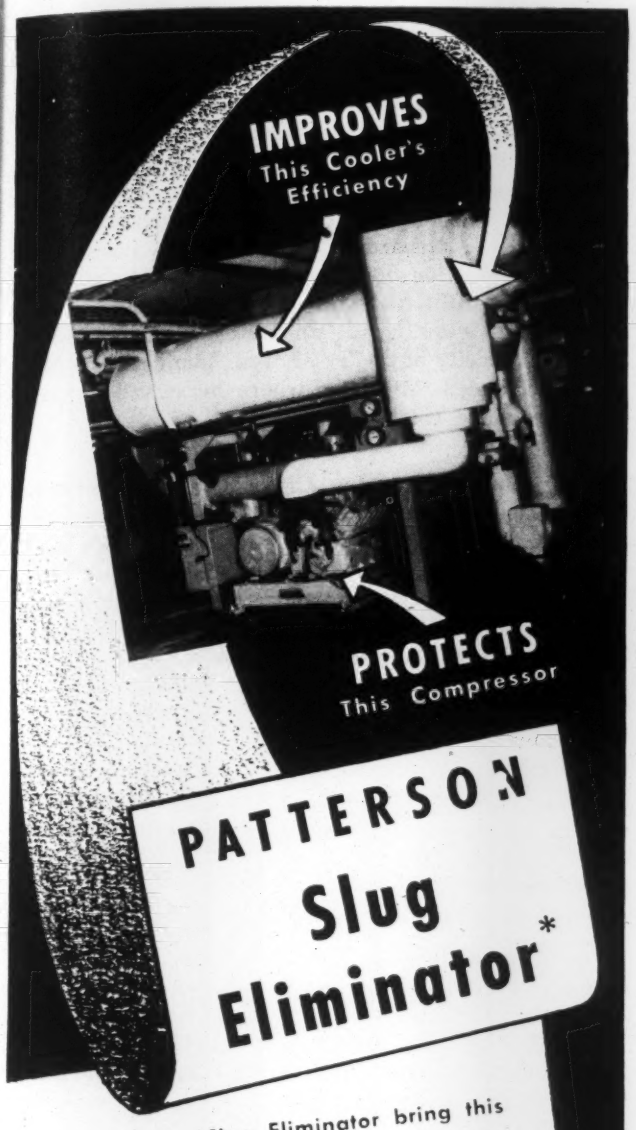
Infra INSULATION, INC.
10 Murray St., N. Y., N. Y.

tioning section, Bureau of Ships, U. S. Navy . . . Three new sales representatives have been named by **Kieley & Mueller, Inc.**, North Bergen, N. J. **Van Hala Industrial Sales Co.**, 1051 Power Ave., Cleveland 14, is the exclusive representative in that area. Exclusive coverage of Pennsylvania, New Jersey, and New York is being handled by **John G. Kirkpatrick**, 4405 Schenley Farms Terrace, Pittsburgh, 13. **Schultz & Martinez**, S. de R.L., Calle Sullivan 119 Mexico D.F., is the representative for Mexico.

Avery Products Co., Cleveland, and **Air Engineers, Inc.**, Birmingham, Ala., are new distributors of glycol vaporizing units for **Air Purification Service, Inc.**, Newark, N. J. . . . **Charles J. Philage** is now acting manager of the advertising department and **Edward J. Sakal** is acting manager of accessory sales in the heating division of **National Radiator Co.**, Johnstown, Pa. As the new sales representative for the northern Ohio area, **Robert G. Harrison** will maintain headquarters in Cleveland . . . Last month, on his 25th anniversary as advertising manager of **Perfection Stove Co.**, Cleveland, **Norman E. Olds** retired. A widely known figure in advertising and a former vice president and director of the Association of National Advertisers, he is actually a 30 year veteran with the company, having served as sales manager of the Canadian branch for five years before becoming advertising manager.

Eugene A. Weaver has left **Surface Combustion Corp.**, Toledo, to establish his own business, as manufacturer's agent on the company's domestic and commercial equipment. The responsibility of general sales management for the firm's aircraft-automotive heating division and the domestic-commercial heating division is now combined under **Robin A. Bell** who was formerly eastern regional manager and assistant sales manager of the domestic-commercial division, and for the past several years sales manager of the aircraft-automotive division. **Harry C. Gurney**, western sales manager, domestic-commercial heating division, is now sales manager of the division and is located at the Toledo general office. **Russell W. Glenn**, of the aircraft-automotive division has been advanced to sales administration manager of the new combined divisions, and **James W. Ashby**, of the aircraft-automotive division is now sales manager of this unit . . . **Black & Decker Mfg. Co.**, Towson, Md., has moved its Indianapolis service station to a new building at 1125 W. 16th St. The branch is in charge of **J. T. Redmon**, service engineer, and **M. D. Mooers**, sales engineer.

Russell R. Gannon Co., 700 Dixie Terminal Bldg., Cincinnati 2, is a new representative for **Illinois Engineering Co.**, Chicago. The firm will cover southwestern Ohio and all of Kentucky . . . The new general sales manager in charge of all district and factory offices for **Combustion Control Corp.**, Cambridge, Mass., is **Laurance D. Sibley**, with the firm since 1945. He was formerly chief engineer of the marine division of Bendix Aviation Corp. . . . **Mercury Sales Co.**, 229 Empire Bldg., Syracuse, N. Y., has been named sales representative for **Welsbach Corp.**, Philadelphia. Representation is being conducted by **R. J. Milholland** and **W. F. Hirsch** who cover the entire state of New York outside of the New York city area.



PATTERSON Slug Eliminator*

How does the Slug Eliminator bring this about?

In protecting the compressor (1), it traps any slugs of refrigerant that might get into the suction line; (2) It changes those slugs of liquid into gas, at high velocity to carry the entrained oil back to the compressor; (3) It assures the return of oil to the compressor.

In improving the efficiency of the cooler (1) it permits safe operation with partial flooding; (2) it subcools the refrigerant on its way to the cooler; (3) it prevents oil logging the cooler.

Thus, with this one single compact unit, those in charge of operations at the Hoffmann-LaRoche, Inc., plant in Nutley, N. J. are being benefited in two ways. This Patterson Slug Eliminator probably would be helpful to you, too. In sending for literature, write us in detail about your refrigerating or cooling system.

*The Patterson Slug Eliminator is protected by U.S. Patent No. 2461342.

EST. 1880

THE PATTERSON-KELLEY Company, Inc.

107 Warren Street, EAST STROUDSBURG, PA.

Offices or Representatives in Principal Cities

Bulletin 8265 Valve for Pressures up to 250 psi

2

STURDY PACKLESS SHUT-OFF VALVES FOR

GAS

OIL

WATER

Bulletin 8268 Valve for Pressures up to 350 psi

These ASCO Valves are small and compact with ample reserve power and large safety factors. Each is available with resilient seat and disc construction to assure absolute bubble-tight seating. The sturdy construction permits exceptionally fast and controlled operation.

Both valves have important "approvals". Bulletin 8265 valve is approved by Factory Mutual and Underwriters' Laboratories; Bulletin 8268 Valve is available with explosion-proof solenoid approved by Underwriters' for Class 1, Group D, Hazardous Locations.

Back of these and the many other ASCO Valves is more than 40 years experience in the design, manufacture and application of solenoid valves. We know this field thoroughly and will be glad to serve you on any automatic control requirement. The above valves are for general purpose use in automatically shutting off the flow of gas, oil or water.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

389 LAKESIDE AVENUE • ORANGE, NEW JERSEY

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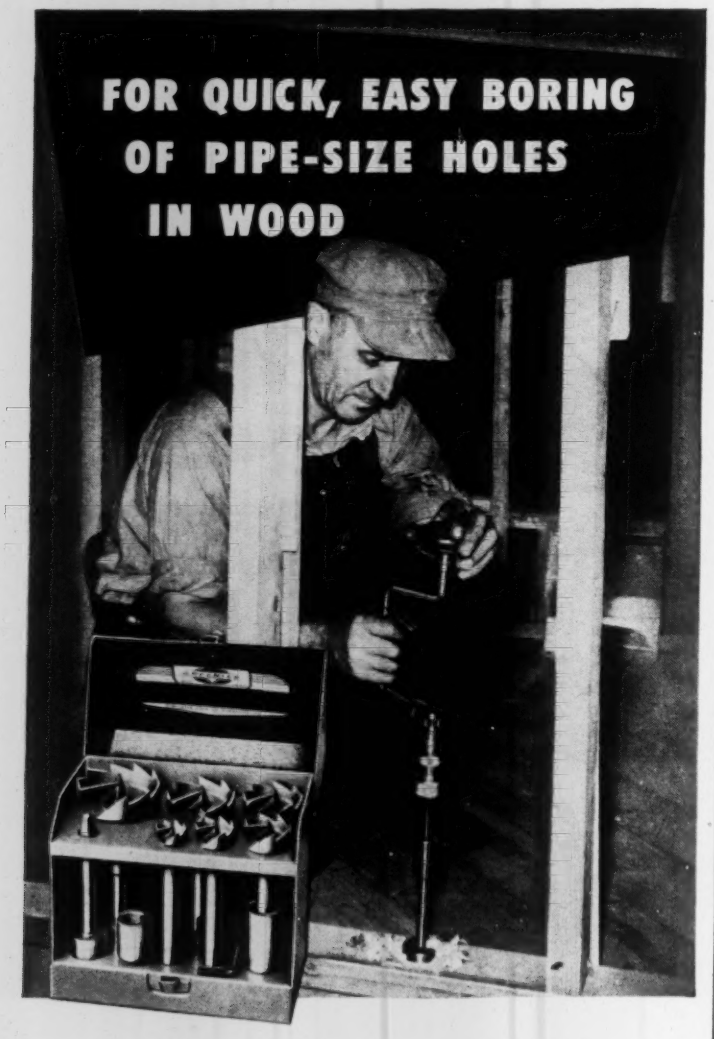


. . . the new GREENLEE PIPE BIT SET

Designed especially for plumbers, steamfitters and electricians to provide fast, easy boring of accurate holes in wood for ½" to 2" pipe and conduit. Makes swift, easy work of an otherwise tedious, hard job! The set is furnished in a sturdy, attractive metal box with convenient carrying handle. Bits have ½" shanks for use in portable electric or pneumatic drills and in stationary boring machines. An adapter is provided for standard auger-bit braces. Adapters are also furnished for using standard ⅜" pipe as an extension for deeper boring and longer reach. Get facts today on these timesaving GREENLEE tools. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 2346 Twelfth Street, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

T. P. Stone and **M. J. Cook** have joined the **Wolverine Tube Div., Calumet and Hecla Consolidated Copper Co.**, Detroit, as salesmen and will call on accounts in Florida, Alabama, Georgia, Mississippi, Tennessee, and North and South Carolina. Mr. Stone, formerly representative for Linde Air Products Co., will temporarily headquarter in Atlantic Beach, Fla. Mr. Cook, who was recently affiliated with Orgill Brothers, Memphis, will headquarter in Atlanta, Ga. . . . **Richard J. Seltzer,** age 36, has been appointed production manager for all plants of **Bryant Heater Div., Affiliated Gas Equipment, Inc.,** Cleveland. He has been with Bryant since May 1948, serving in an advisory capacity at the Tyler, Tex., plant. Previously he was with Rheem Mfg. Co., where he served in various capacities since 1938.

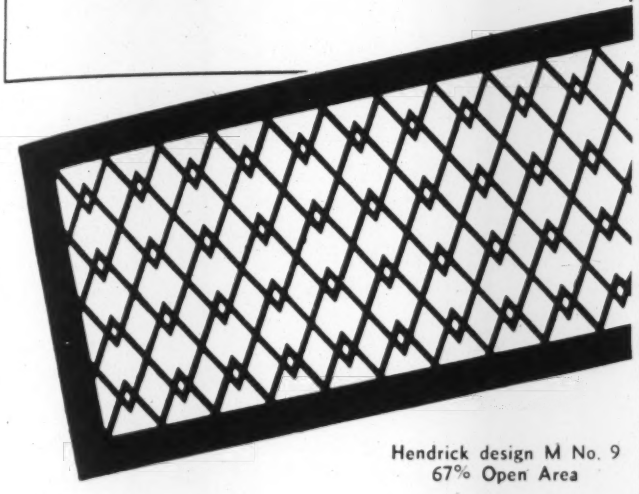
Tinnerman Products, Inc., Cleveland, has moved its New York district office to new and larger quarters at 73 Roseville Ave., Newark, N. J. Under the direction of **R. M. Negley,** district manager, the office will continue to serve northern New Jersey, northeastern Pennsylvania, the New England states, and all of eastern New York state. **Wendell Garman** has been named personnel manager for the firm. He was formerly with Harris-Seybold Co., Thompson Products, Inc., and Towmotor Corp. . . . **Lloyd L. Connell,** who recently resigned as technical director of the **Stoker Manufacturers Association,** was accorded a testimonial dinner sponsored by members of the association's engineering and research committee. He is now affiliated with **Diamond Chain Co.,** Indianapolis, in a sales engineering capacity.

Penn Electric Switch Co., Goshen, Ind., has named **L. J. Krause Co.,** 200 Lumber Exchange, Minneapolis, representative in Minnesota, North and South Dakota, and western Wisconsin. Previous to forming his own company, Mr. Krause was with Minneapolis-Honeywell Regulator Co. . . . **M. V. Osterhout,** Milwaukee branch manager for **American Radiator & Standard Sanitary Corp.,** is now supervising the company's south central division. He has been succeeded as Milwaukee manager by **Francis P. McAneny,** a member of the sales force in that city. **Darvin O. Rouzer,** of the Altoona sales office is now managing the new branch office at Parkersburg, W. Va.

Magnetrol, Inc., Chicago, has appointed **Cochrane Steam Specialty Corp.,** 80 Federal St., Boston, exclusive sales representative for Massachusetts, Rhode Island, Maine, New Hampshire, Vermont, and a part of Connecticut. The Los Angeles area and southern portion of California, together with Arizona and Nevada, are now being served by **Berkley Engineering and Equipment Co.,** 2417 Riverside Dr., Los Angeles. Trade in the northern half of California is being served by **Johnson Engineering Co.,** 534 20th St., Oakland . . . **Airo Supply Co.,** Chicago, has promoted **C. J. Bernens** from the position of office and credit manager to business manager. **Carl Formento,** formerly an assistant in the purchasing department, is now purchasing agent. . . . **Russell C. Westover, Jr.,** has become president of **Ray Oil Burner Co.,** San Francisco, and has succeeded **Mrs. R. C. Ray** who has retired from active management but remains a director of the company. Mr. Westover has long been identified with the firm as a director and business adviser.

Decorative Grilles

suitable for Bulator Installations



Hendrick design M No. 9
67% Open Area

For use with the new Hendrick BULATOR*—the first practicable combination of a deflecting vane grille with an ornamental grille—there is a wide choice of Hendrick Ornamental Metal Grilles that have the proper open area.

The ornamental grille does not appreciably affect the desired air throw and spread, and the deflecting vane grille is not noticeable although mounted directly behind the ornamental grille.

The vanes of the deflecting grille are adjustable so that the air flow can be deflected to right or left, up or down, or in a combination of directions.

The BULATOR enables the architect to combine with the air-conditioning system of a building, a design of ornamental grille which harmonizes with the decorative scheme he has chosen.

Write for Bulator folder and detailed information on the many Hendrick ornamental grille designs that have the essential open area for Bulator installations.

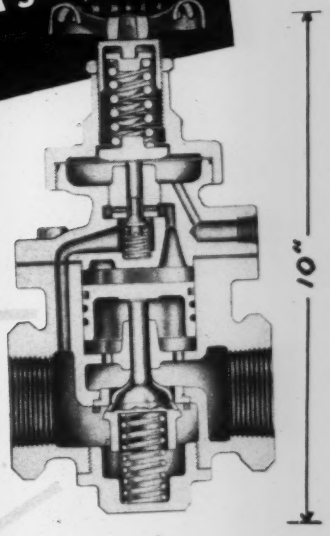
*Beauty + Ventilator

SEE OUR CATALOG IN SWEET'S

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

HENDRICK
Manufacturing Company
48 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

FOR CLOSE REGULATION AND COMPACT SIZE USE K&M's #481



Parabolic Inner Valve insures reliable control on all load requirements.

Single seat design for tight shut-off in dead end service.

You can remove and renew any working part without removing the valve from the line.

For rugged build, convenient size and "close tolerance" regulation of steam—you just can't beat K&M's valve type 481.

It's an internal pilot-operated pressure regulating valve, widely used in process services and marine work as a primary valve on two stage reductions.

Changes in pressure reduction are made by setting the hand wheel. For complete specification data, ask for Bulletin 1000.

The Kieley & Mueller policy of continued pioneering has helped the K&M reputation grow constantly throughout the past 69 years. Look to K&M for: BACK PRESSURE REDUCING VALVES • PRESSURE REDUCING VALVES • STRAINERS • ATMOSPHERIC RELIEF VALVES • STOP and CHECK VALVES • STEAM SEPARATORS • GREASE EXTRACTORS.

FOR ACCURACY • RUGGEDNESS
COMPACTNESS • ACCESSIBILITY
SPECIFY K&M's #481

KONTROL MOTOR
NORTH BERGEN N.J.

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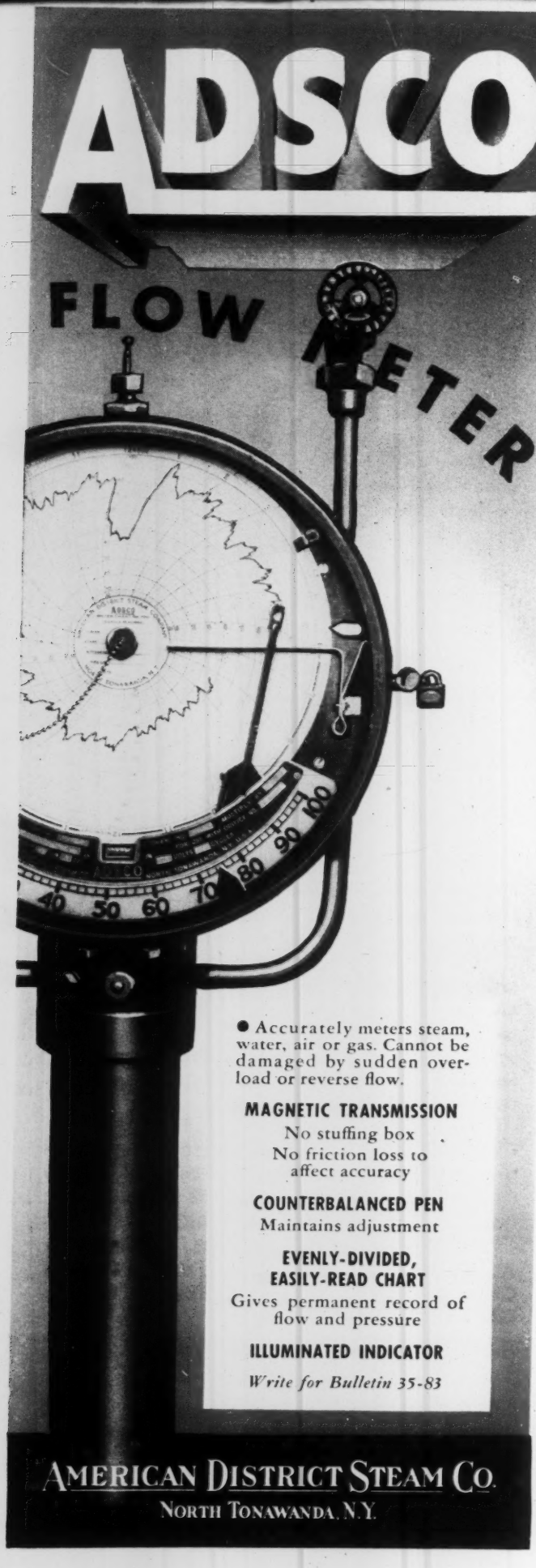

ADSCO
FLOW METER
40 50 60 70 80 90 100
● Accurately meters steam, water, air or gas. Cannot be damaged by sudden overload or reverse flow.
MAGNETIC TRANSMISSION
No stuffing box
No friction loss to affect accuracy
COUNTERBALANCED PEN
Maintains adjustment
EVENLY-DIVIDED, EASILY-READ CHART
Gives permanent record of flow and pressure
ILLUMINATED INDICATOR
Write for Bulletin 35-83
AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

NEW BOOKS & REPORTS

Finds Heat From Fusion of Soil Moisture Unimportant for Ground Coils

A moist soil is superior to dry soil insofar as the heat absorption rate of a buried tube is concerned, and this applies for both frozen and unfrozen soil. Although at first glance it might appear that heat obtainable from the fusion of soil moisture would be fairly large, this factor is actually of little importance. However, the freezing of moist soil increases the thermal conductivity in the frozen zone. Small tubes are preferable to large ones, the optimum being between ½ and ¾ in. diameter. These are some of the conclusions of C. H. Coogan, Jr., head mechanical engineering department, University of Connecticut, as set forth in his paper, Heat Transfer Rates—Experimental Determination for Heat Absorbing Coils Buried in the Earth.

Presented at the recent spring meeting of the American Society of Mechanical Engineers, the paper gives the results of an investigation of heat transfer between earth and copper tubes buried horizontally in coil form and at depths from 4 to 8 ft below the surface. Seven different coils were used and tests were run for various periods from June 1947 to July 1948.

Copies of the report, identified as Paper No. 49-S-10, may be obtained from ASME headquarters, 29 W. 39th St., New York 18.

Tells ASME Performance Improved, Smoke Abated by Overfire Air Jets

Improvements in furnace performance and smoke abatement have been shown on all types of stoker fired and hand fired furnaces by the use of overfire jets. William S. Major, development engineer for Bituminous Coal Research, Inc., reported in a fuels session at the recent spring meeting of The American Society of Mechanical Engineers, 29 W. 39th St., New York 18. He said maximum benefits from jets are most likely to occur on spreader stoker fired furnaces.

The use of jets has not only been effective in substantially reducing smoke density, he declared, but it "has increased boiler and furnace efficiency, reduced soot and slag deposits on boiler and economizer surfaces, reduced both the quantity and carbon content of the cinder carryover, shortened the flame and reduced the final temperatures when surfaces are of the same degree of cleanliness and has enabled furnaces to operate with slightly lower excess air without unburned combustible gases."

Although overfire jets for improving combustion and abating smoke have been used to a limited extent for many years with varying degrees of success, Mr. Major said, the extensive adoption of jets has taken place during the past few years as a result of increasing demands for reduction of air pollution.

Standardizes Welding Terms and Definitions, Lists Processes

Recognizing the importance of clarity in making understood and understanding technical communications, the American Welding Society has formulated a standard terminology for welding. The result of four years of intensive effort, the standard contains more than 500 terms

Where you have heat, smoke and fumes in concentrated quantities, it takes *power* to expel these elements fast enough to clear the atmosphere for greatest comfort. Swartwout Ject-O-Valve forces contaminated air outside before it spreads through workrooms—draws *fresh* air in from outer walls.

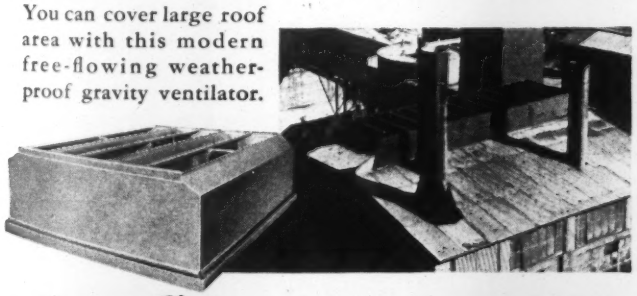
Ject-O-Valve (patent applied for) is sturdy, powerful, efficient. It literally "throws" bad air *out* and *up*. The top is open only when fan is running. Weatherproof at all times. Made in 5 sizes, 28 capacities—6,400 to 46,500 C.F.M.

It pays you to have this flexible ventilation facility, to help keep workers satisfied, more efficient. Write for full information.

THE SWARTWOUT COMPANY
18568 Euclid Ave., Cleveland 12, Ohio

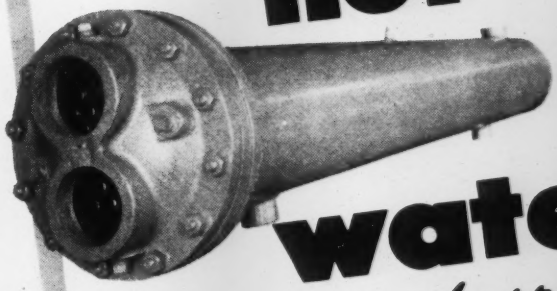
Swartwout *AIRMOVER* for "open roof" ventilation

You can cover large roof area with this modern free-flowing weatherproof gravity ventilator.



Swartwout *Controlled* **Air Circulation**
EQUIPMENT FOR EFFECTIVE ECONOMICAL VENTILATION OF INDUSTRIAL BUILDINGS

hot water *in a hurry!*



Where sudden hot water pulls—or an unpredictable time schedule—are in the order of things, install

Paracoil INSTANTANEOUS WATER HEATERS

TO KEEP PACE WITH THE LOAD—ALL THE WAY!

No storage tank is necessary—they have enough, and more, heating surface built into them to heat the water as fast as it is drawn! Thousands in use.

If you have such a problem, we have the answer! Stock designs permit quick deliveries..at prices lower than you think!

Write today for a copy of our new Bulletin 70 Section I, describing this line of Paracoil Water Heaters.

This bulletin, in addition to tables of capacities and physical dimensions on our U-Tube designs, contains a wealth of practical, worthwhile engineering data on how to size, figure steam requirements, and pipe up PARACOIL INSTANTANEOUS WATER HEATERS. YOUR COPY AWAITS YOU!

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feeding up to 1000 lbs. per hr.

Factories, plants, shops, stores, theaters, hotels, apartment houses, other large private and public buildings . . . all use *big quantities* of heat, hot water or steam . . . all can show *staggering fuel costs!*

Yet you can cut those costs . . . cut them up to 30% . . . with Combustioneer Automatic Coal Stokers. Think of that saving . . . monthly . . . or *yearly!*

Combustioneer gets *all* the heat *out* of the coal. Its exclusive "Pulsating" Transmission, Automatic Respirator and "Breathing" Fire-Bed assure highest efficiency combustion under all conditions and provide perfectly controlled automatic heat. And Combustioneer's extremely rugged design and construction pay off in long-lived dependability and lowest maintenance cost.

Hopper and bin-feed models, capacities up to 1000 lbs. per hr. Write us today for further information about how Combustioneer is saving money in your specific kind of business and can save money for *you.*

THE STEEL PRODUCTS ENGINEERING CO.
1236 W. Columbia St., Springfield, Ohio

Please send us, without obligation, further information about your commercial models of Combustioneer, and information about your free heating analysis.

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and 57 illustrations. Many basic concepts are defined and distinctions between related terms are made, such as fusion, penetration, and bond, bead weld and weld bead, backing weld and back weld, etc.

An important aspect of the work involved was the necessity of verifying that basic terms are applicable to all types of welding. A chart of 37 welding processes and process charts comparing these processes on the basis of fundamental characteristics important in production welding were developed and used.

Copies of Standard Welding Terms and Their Definitions may be obtained for $1.00 from society headquarters, 33 W. 39th St., New York 18. Copies of the Master Chart of Welding Processes and Process Charts are available for 35 cents per set of five. If the standard and charts are ordered together, the price is $1.25.

Presents Philosophy and Ethics a Young Engineer Needs

A guide for the professional life of the young engineer, largely the work of the late Dr. William E. Wickenden, for 18 years president of Case Institute of Technology, was begun by him in 1942. After his untimely death in 1947, before he completed his final version, G. Ross Henninger, director of publications of the Illuminating Engineering Society, undertook the task of editing the final version.

The book presents the philosophy and engineering ethics a young engineer needs for success, as viewed by Dr. Wickenden. It opens with a historical survey of the engineer's heritage, going back to Tubal Cain, and describes the beginnings of engineering societies. From there the author traces the engineering profession through its every aspect—what the young engineer can expect to find, the difference between a trade and a profession, professional relationships, finally ending the book with his famous essay on the philosophy of life, The Second Mile.

Addenda to the book are Faith of the Engineer, a credo accepted by the Engineers' Council for Professional Development, a recommended reading list for junior engineers, a self appraisal questionnaire, and canons of ethics for engineers.

A Professional Guide for Junior Engineers is published by the Council. Copies may be obtained from the headquarters office at 29 W. 39th St., New York 18, for $1.00.

Fiber Insulating Board Standard to Include Flame Retardant Interior Boards

A recommended revision of Commercial Standard CS42-43, Structural Fiber Insulating Board, has been submitted to producers, distributors, and users for acceptance.

Proposed by the Insulating Board Institute, with the endorsement of the standing committee, the revision includes Class F, Interior Boards (flame retardant surface), additions to Table 2, covering physical requirements for tensile strength perpendicular to surface, together with illustrations and methods for testing.

Mimeographed copies of the recommended revision (TS-4777) are available and may be obtained, as long as the limited supply lasts, from the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

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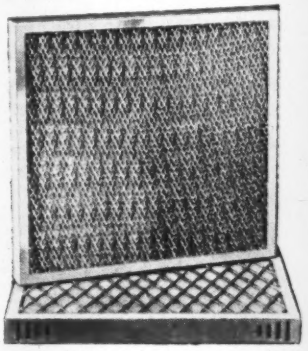
Air Filters Trap More Dust

For Air Conditioning, Heating and Ventilating



Greater efficiency — lower resistance is yours with an AIRSAN Air Filter.

A permanent, cleanable viscous type filter of all galvanized construction, having full bronze welded corners. Expanded metal face plate acts as lint arrestor to provide easier cleaning and servicing. Rated filtering efficiency 98.5%. In standard 1" and 2" thickness.

Also available for heavy duty service on industrial and special applications — in 2" to 4" thickness. Holding frames (for V-type or straight banks) are made for all type filters.

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NOW... Fedders makes Convector-Radiators in America's most *complete* range of types and sizes as follows:

Type F	Type SFB	Type RC
Type FE	Type W	Type RCB
Type FB	Type S	Type P
Type SF	Type R	Type PB
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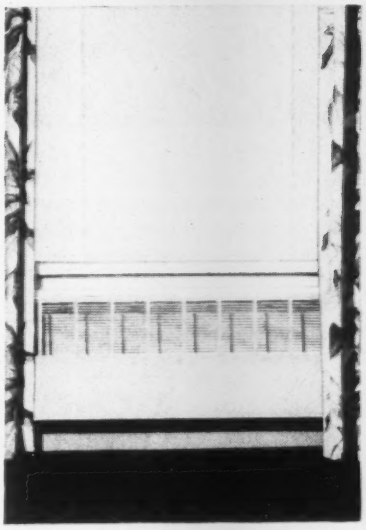

to manual and thermostatic control is an important reason for using Fedders Convector-Radiators. They are equipped with heating elements using copper tubes and aluminum fins,—the most efficient commercial heat transfer metals.

By reducing time lag, Fedders Convector-Radiators provide quick control and more uniform temperature, greater comfort and increased fuel economy.

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Other Books and Reports Received

Odors, Physiology, and Control, by Carey P. McCord, Industrial Health Conservancy Laboratories, and William N. Witheridge, ventilation consultant, General Motors Corp.—Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, contains 405 + x pp. (6 x 9 in.) is clothbound, and is priced at $6.50. Presents a comprehensive analysis of odor perception, measurement, classification, and regulation. To be reviewed in a forthcoming issue.

Panel Discussion on Influence of Nonferrous Metals and Their Compounds on Corrosion of Pressure Vessels—A 45 page pamphlet published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3 and priced at $1.00. This is a reprint of the proceedings of the symposium at the 51st annual meeting of the society. Two papers and discussions are included. One deals with station design and material composition as factors in boiler corrosion and R. B. Donworth, betterment engineer, power stations dept., Duquesne Light Co. is the author. The other, by Richard C. Corey, supervising engineer, combustion research section, central experiment station, Bureau of Mines, discusses corrosion of high pressure steam generators with emphasis on the effect of copper and iron oxide deposits on steam generating tubes.

Meat Packing Plant Refrigeration, Part I Carcass Coolers, by J. S. Bartley, K. E. Wolcott, and J. P. McShane—In the form of a 10 page bulletin, it is identified as Application Data Sheet No. 45, is priced at 50 cents, and is published by the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18. Gives details on the design, construction and operation of chilling coolers and holding coolers for beef and hogs and chilling coolers for lambs and calves.

Proceedings, 1948 Annual Meeting, Engineering College Research Council of the American Society for Engineering Education—Contains several papers dealing with administration of sponsored research at a number of colleges and universities. Another paper covers the functions of the engineering experiment station in a graduate program, and several compilations of research projects now under way reflect a great deal of activity in fields which are of direct interest to the heating, ventilating, and air conditioning engineer. The annual report of the council is included. Copies may be obtained for $1.00 from the council at the college of engineering, State University of Iowa, Iowa City.

Course in Plumbing and Pipe Fitting—Part I, Basic Principles of Plumbing, Heating, Refrigeration, and Air Conditioning. Prepared by the instructional materials laboratory, bureau of trade and industrial education, California State Department of Education, Sacramento, it is a workbook for apprentices in the plumbing and pipe fitting trade. Beginning with elementary arithmetic, it is concerned with fundamentals and is essentially an outline book as it indicates reading assignments and problems in other publications.

Eventually...you will use

AMINCO DUNMORE

THE most sensational device ever introduced for measuring, indicating, recording and controlling relative humidity.

It has outmoded older types (such as those employing hair, animal tissue, bone, wood, plastics, etc.) by virtue of its amazing characteristics and performance. HERE'S WHY!

MOST SENSITIVE

Detects humidity changes as small as plus-minus 0.15% relative humidity.

SPEEDIEST IN RESPONSE

Responds instantly to micro changes in relative humidity at temperatures from 40° to 140° F. Response is slightly slower below 40° F., whereas other types are unresponsive.

MOST ACCURATE

Measures accurately within plus-minus 1½% relative humidity, without periodic attention.

OCCUPIES LESS SPACE

Sensing element occupies a maximum of two cubic inches.

MOST RELIABLE

Guaranteed for one year. Will give many more years of satisfactory service when used properly.

MOST VERSATILE

1. Can be used to measure, indicate, record and/or control relative humidity, also to drive air-operated devices.

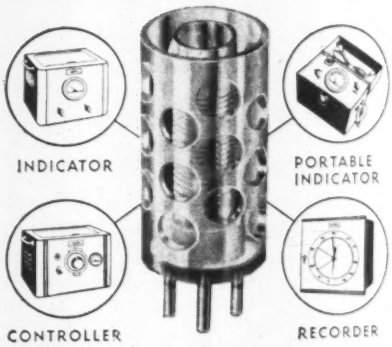
2. Can be used for remote control operation, since long connecting lines may be employed.

3. Since it does not add or remove moisture or heat, it can be built into hermetically-sealed electrical components.

4. The small size and weight of the sensing element enhances its adaptability.

5. Measures moisture content of solids as well as of air and other non-corrosive gases.

ELECTRIC HYGROMETER



This tiny element (illustrated actual size) is used in conjunction with one or more of the instruments shown in circles above for obtaining various combinations for measuring, recording, and controlling relative humidity.

PROMPT DELIVERY

Write for Bulletin 2164 F

AMERICAN INSTRUMENT COMPANY
Silver Spring, Maryland

"They* use RP Self-Seal Air Filters.."

REPUBLIC AVIATION CORPORATION*
Farmingdale, L. I., N. Y.

*Designers and Builders of Famous F-84 THUNDERJET, First 600-mile-per-hour fighter for U. S. Air Forces

. . . Cut Air Filter Cost in *Half*

With more than 20,000,000 cubic feet of air per hour needed for air filtering operations at their large Farmingdale, Long Island plant, Republic gives more than casual attention to air filter costs and efficiency.

R-P Air Filters are used in 90% of Republic's air conditioning and air tempering systems. A thorough analysis made by their engineers sometime ago indicates that wherever standard replaceable filters were used, R-P Self-Seal Replacement Pad Filters "cut air filtering costs by about one-half." In addition, the R-P Filters lasted longer than many filters costing up to twice as much. Another reported advantage was the excellent "holding, packing, and dirt distribution" characteristics of R-P Filters. There was no surface clogging to excessively cut down air flow, for R-P Filter media holds dirt throughout its depth, not just on the surface layer.

RP "Snap-In" Grids Used

At Republic, as in many other large installations, R-P "Snap-In" grids also avoid the cost on constantly replacing filter frames or grids.

R-P "Snap-In" grids last for years—only the filter pad need be replaced. They're time-savers, too, in filter replacement.

Typical savings in time and money, improvement in air cleaning efficiency, can be yours, too, with R-P Air Filters.

Check them all—to your own profit.

Call your local R-P Filter Dealer, or write for new Techni-Data Sheets.

RP Products Include:

• Fiber Self-Seal Air Filters • ALUMALOY Self-Seal Air Filters • Cardboard Frame Replacement Filters • ALUMALOY E Z Kleen Air Filters • ALUMALOY Industrial Washable Filters • ALUMALOY Grease Filters • "Snap-In" Grids for Filter Banks • Self-Seal Replacement Pads • Roll Filter Media • Filter Bank Frames • Special R-P Filter Coat

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Canadian Representative—Delhi Industries, Delhi, Ontario

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RP FILTERS . . . FOR FINER LIVING
CHOSEN AS STANDARD EQUIPMENT BY LEADING MANUFACTURERS

HERE'S THE *Heating Equipment* DESIGNED FOR THE *Flexibility You Need!*

THERMOBLOC

ONE NO. 550 THERMOBLOC

550,000 b.t.u.'s per hour
2290 sq. ft. of radiation
567 pounds of steam per hour
16.4 developed boiler horse power

THERMOBLOC EQUIVALENT IN BOILER CAPACITY

ONE NO. 300 THERMOBLOC

300,000 b.t.u.'s per hour
1250 sq. ft. of radiation
309 pounds of steam per hour
8.96 developed boiler horse power

These two sizes of THERMOBLOC were arrived at by careful analysis of average plant requirements. Total outputs up to MILLIONS of b.t.u.'s can be obtained by combinations of these two sizes. Such well deployed installations will assure more uniform temperatures than can be maintained by excessively large units, and they will avoid the piping and fitting expense that results from the use of many units of small outputs.

Due to their simplicity, the THERMOBLOCS can be bought and installed for approximately ONE-THIRD the cost of a boiler and steam distributed system. Their notably higher over-all efficiency (82-86%) enables THERMOBLOCS to maintain required temperatures with a lower rate of fuel consumption.

For those who have heating requirements to figure, THERMOBLOC has just prepared a new bulletin containing engineering data tables and information on heating constants and building materials. With this bulletin you can estimate the number and size of THERMOBLOCS to supply the necessary heat load.

Send today for this bulletin, and you can make accurate forecasts of fuel consumption! And for further proof, ask us for a reprint of an article published in Operating Engineer, on how one manufacturer reduced heating costs with THERMOBLOC.

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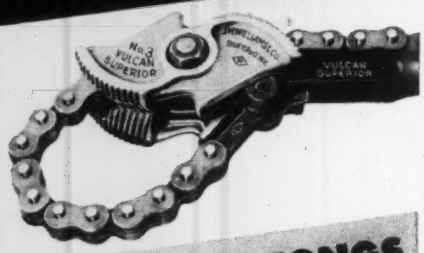
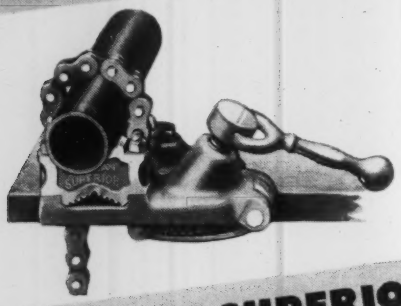


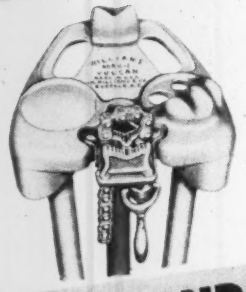
7 sizes, with either flat link or cable chain, for pipe and fittings 1/8 to 12".

"VULCAN SUPERIOR" TONGS



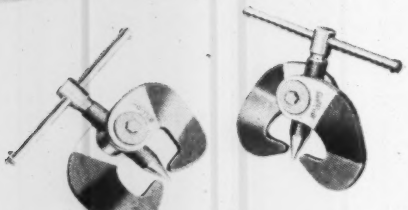
2 sizes, for pipe 1/8 to 4½". Handle is on top for easy operation.

"VULCAN SUPERIOR" VISES



"Vulcan" No. AV-1 for pipe 1/8 to 2". A light weight aluminum stand having same strength and rigidity as steel types weighing twice as much.

ALUMINUM VISE STAND



For fast, easy gasket replacement. 2 sizes, for pipe 3/4 to 48".

WILLIAMS FLANGE JACKS

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Sold by Industrial, Plumbing and Oil Field Distributors everywhere. Literature on request.

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MEETINGS & CONVENTIONS

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1—1949 annual meeting, French Lick Springs, Ind., June 13 and 14. The meeting will be open to individuals and representatives of allied industries and organizations upon invitation.

The major portion of the technical conference will be devoted to smoke abatement and air pollution.

The 15th National Applied Mechanics Division Conference of ASME, June 13 to 15, University of Michigan, Ann Arbor, Mich.—The meeting, planned in cooperation with the Detroit section of the American Society of Mechanical Engineers, will feature the presentation of numerous technical papers. Included is one on graphical, mechanical, and electrical aids for compressible fluid flow by H. Poritsky, B. Sells, and C. E. Danforth, General Electric Co. Another will present stress studies on piping expansion elbows by F. J. Feely, Jr., group head, and W. M. Goryl, engineer, mechanical engineering branch, Esso engineering dept., Standard Oil Development Co.

Room reservations should be secured from Prof. E. L. Ericksen of the mechanical engineering department of the university.

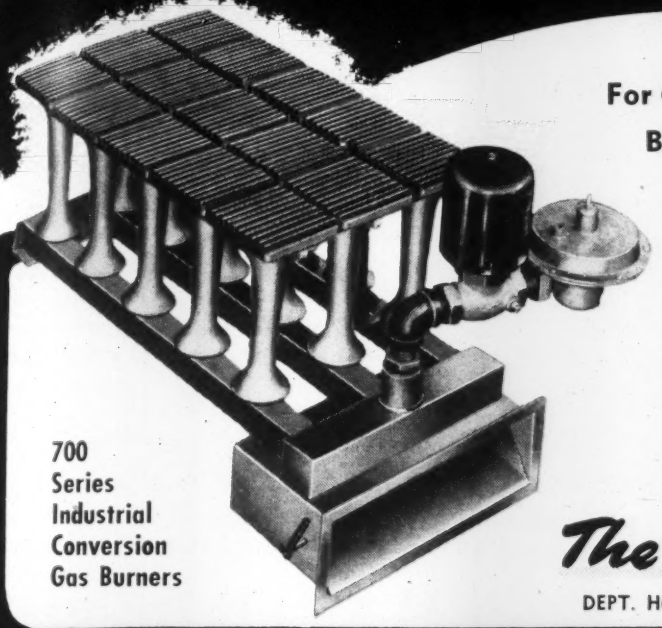
The 2nd National Catholic Building Convention and Exposition, June 14 to 16, Stevens hotel, Chicago.—Sponsored by St. Joseph's College, Rensselaer, Ind. Three major sessions covering architecture, materials, and contracting are scheduled and more than 135 firms serving the Catholic building market will exhibit products. H. M. Lawrence, chief materials engineer, American Standards Association, will give a talk on what the Catholic administrator should know about building materials. Panel members will be representatives from the National Bureau of Standards, National Fire Protection Association, Producer's Council, American Society for Testing Materials, Building Officials Conference of America, and the American Society of Mechanical Engineers.

Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17—Third IBR short course on steam and hot water heating, University of Illinois, Urbana, Ill., June 14 to 17. The program will consist of a number of lectures and problems covering the design of various types of systems. Both a beginners' course and an advanced course for those who attended one or both of the previous sessions will be given.

Considerable new material (including a study of the new installation guide on baseboard heating) not covered in previous courses will be presented. One of the features will be a discussion of merchandising hot water and steam heating systems.

The 4th International Gas Conference, June 15 to 17, London, England—Sponsored by the International Gas Union, comprised of national gas associations throughout the world. Additional information may be obtained from the American Gas Association, 420 Lexington Ave., New York 17.

Reinhard* "CUSTOM BUILT"
Industrial Gas Conversion Burners



700 Series Industrial Conversion Gas Burners

For 60,000 to 2,000,000 BTU Requirements

Reinhard Industrial Gas Conversion Burners (700 series) are built to meet specifications requiring 60,000 to 2,000,000 BTU's . . . . for cast iron sectional and steel fire box boilers.

The cast burner heads employ the Up-Shot principle and will withstand tremendous heat. They make maximum use of fuel to give real fuel economy. Exceptionally quiet in operation.

Write for complete information, prices and specifications. No obligation.

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Quality products for over 47 years

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weil "TVC" LOW RETURN CONNECTION CAST IRON RECEIVER

GUARANTEED PERFORMANCE

- *Precision-built for longer life*
- *Every pump part made and assembled in the Weil Factory*
- *Pre-tested before shipping*
- *Pump comes completely assembled*

TYPE R
Hot and Chilled Water Circulating
Ball-bearing — once a year lubrication
Capacity — 10 to 750 GPM
(write for bulletin R5500)

TYPE TR HORIZONTAL
Low and High Pressure Systems
Ball-bearing — heavy duty
Capacities to 100,000 sq. ft. E.D.R.
Pressures to 125 P.S.I.

Low return connections provide freedom of layout. Eliminates underground lines. Overhead lines may be used. Has extremely low waterline—cast iron receiver. Capacities—500 to 10,000 sq. ft. E.D.R.
(write for bulletin TVC-300)

TYPE "TVC" CONDENSATE
LOW PRESSURE SYSTEMS

Fig. 302

weil PUMP COMPANY 1523 North Fremont Street Chicago 22, Illinois

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3rd Annual Store Modernization Show, June 19 to 24, Grand Central Palace, New York City—Daily conferences will be conducted under the direction of the New York University School of Retailing. Admission tickets, as well as invitations, can be obtained from the school or from the Store Modernization Institute, 40 E. 49th St., New York 17.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—1949 semi-annual meeting, June 20 to 22, Minneapolis. For details see the ASHVE Journal Section in this issue.

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—Mid-year convention, June 21 and 22, Edgewater Beach hotel, Chicago.

American Society for Testing Materials, 1916 Race St., Philadelphia 3—The 52nd annual meeting, June 27 to July 1, Chalfonte-Haddon Hall hotel, Atlantic City. In addition to 22 technical sessions officially scheduled, informal sessions and round table discussions will be held. Symposiums and technical papers will deal with ferrous and nonferrous metals, rapid identification of metals, ultrasonic testing, fatigue of metals, evaluation tests for stainless steels, and testing cast iron with strain gages.

The first Pacific area national meeting of the society will be held at the Hotel Fairmont, San Francisco, the week of October 10. Some 70 technical papers are scheduled and many technical committees will hold sessions.

Instrument Society of America, 921 Ridge Ave., Pittsburgh 12—The 4th annual conference and exhibit, September 12 to 16, Municipal Auditorium, St. Louis. A pre-convention instrument maintenance clinic will be held September 9, 10, and 11 at the Statler hotel.

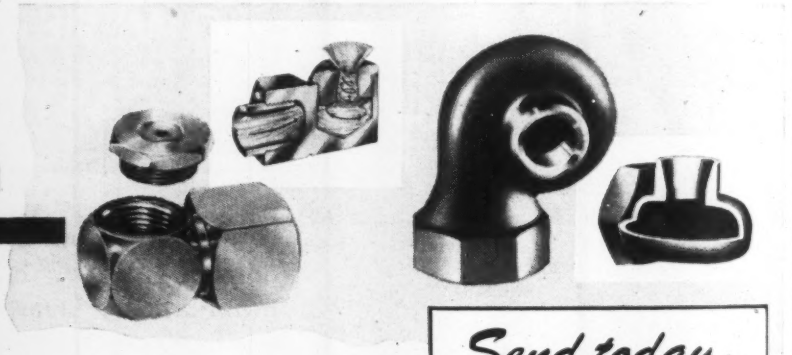
National Association of Corrosion Engineers, south central regional meeting, Adolphus hotel, Dallas, Tex., October 3 and 4. Chairman of the committee on arrangements for the south central region is G. R. Olson, United Gas Pipe Line Co., Box 1407, Shreveport 92, La.

American Welding Society, 33 W. 39th St., New York 18—The 30th annual meeting and exposition will be held in Cleveland, the week of October 16.

As usual, the meeting will be held during the National Metal Congress and Exposition. The society has reserved a block of rooms at the Hotel Cleveland, headquarters for the meeting. When the quota is filled, room applications will be referred to the Metal Congress Housing Bureau.

The 37th National Safety Congress and Exposition, October 24 to 28, Chicago. Sessions on industrial safety are scheduled for the Stevens, Congress, and Morrison hotels. Further information can be obtained from R. L. Forney, general secretary, National Safety Council, 20 N. Wacker Dr., Chicago 6.

Only 7 lbs. pressure provides
FINE, UNIFORM BREAK-UP
AND DISTRIBUTION OF FLUID



with
Binks
ROTOJET
clog-proof
spray nozzles

Absence of internal vanes and obstructions permits maximum spraying efficiency at extremely low pressures with Binks Rotojet Spray Nozzles. Designed on the off-center inlet, whirl chamber principle for greatest spraying effectiveness. Sizes up to ¾" pipe connection are of two-piece construction, precision-machined from finest quality brass bar stock, stainless steel or any special alloy that is machinable from bar stock. Sizes from 1" to 2½" have strong cast one-piece bodies. Wide capacity range.

Send today for
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Bulletins give full information on sizes and capacities of the following Binks Rotojet Nozzles:
Bulletin Numbers:
10. Small and Medium Capacity Nozzles
11. Nozzles for Brine Spray Operation
12. Large Capacity Nozzles
13. Nozzles for Spray Ponds
14. Nozzles for Metal Cleaning Operations.
Please state how nozzles will be used, giving installation capacity.

THERE'S A BINKS SPRAY NOZZLE FOR EVERY SPRAY JOB
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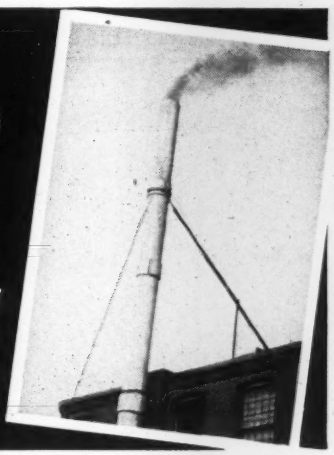
REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVENUE, CHICAGO 12, ILL.

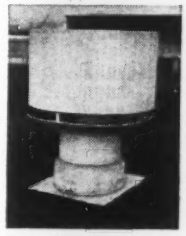
Why tough venting problems present few problems...



...for Transite Industrial Vent Pipe

Neither sun, nor rain, nor snow . . . nor the usual run of corrosive fumes, vapors, dusts and gases present a problem with Transite* Industrial Vent Pipe on the job.

That's because this Johns-Manville asbestos-cement product cannot rust . . . has the ability to stand up against many corrosive agencies. Thus, it helps avoid costly replacements . . . helps effect reductions in plant maintenance costs.



Where venting systems run through the roof, Transite Ventilators provide the same corrosion resistance service as Transite Industrial Vent Pipe.

Adaptable to many venting jobs—Transite Industrial Vent Pipe may be used for vents, ducts or stacks. Its wide range of sizes (up to 36" diameter) adapt it to practically any job requirement. And a complete line of Transite fittings insures corrosion resistance throughout the venting system.

Easily installed—This pipe presents no installation problems. Light in weight, it is readily handled—and can be cut and drilled on the job with ordinary tools. Yet its durable asbestos-cement composition assures long-term, dependable service—an advantage proved in numerous industrial venting installations.

For additional information about Transite Industrial Vent Pipe, write for Data Sheet, Series DS-336. Address Johns-Manville, Box 290, New York 16, N. Y.

*Transite is a Johns-Manville registered trade mark.

Typical Industries in which Transite Industrial Vent Pipe is used:

Aircraft	Foundry	Quarrying
Automobile	Furnace	Railroad
Baking	Furniture	Rayon
Bleaching	Gas	Refrigeration
Boiler Works	Glass	Rubber
Brewing	Laboratory	Shipbuilding
Canning	Laundry	Sewage Works
Ceramic	Leather	Shoe
Chemical	Meat Packing	Smelting
Dairy	Metal	Soap
Drug	Mining	Soft Drink
Electrical	Paint	Sugar Refining
Explosive	Petroleum	Textile
Farm Machinery	Potash	Tool
Food	Pulp & Paper	Water Works

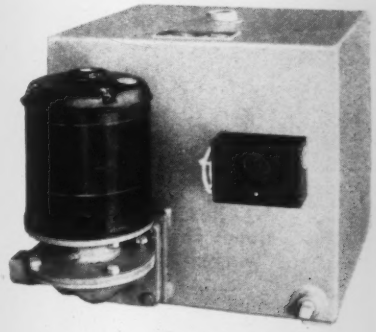
Johns-Manville TRANSITE Industrial Vent PIPE

A HIT from the start! the Sterlco 4100 SERIES CONDENSATION PUMP

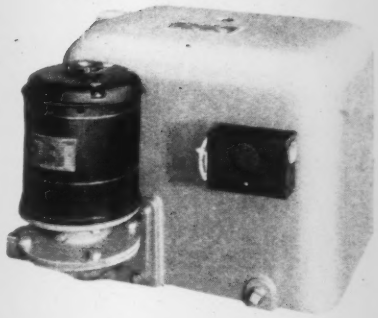
The popularly priced 4100 Series pump, the newest addition to our complete line of condensation pumps, has really "hit the bullseye" with users. Its compactness and neat appearance, its simplicity and sturdiness of construction, its conservative rating for handling emergency overloads, have all contributed to its enthusiastic acceptance.

Before you specify or buy a small condensation pump, be sure to find out about the many quality features of the 4100! The coupon below will bring full information.

The 4100 Series is particularly attractive as a stock unit. Wide range of capacity and pressure ratings in one unit eliminates stocking number of pumps. Requires less than 2¼ sq. ft. of storage space, stacks conveniently.



Sterlco 4100 Series Condensation Pump with steel tank. ¼ H.P. capacity up to 6000 sq. ft. E.D.R. at 20 lbs. Also ½ H.P. unit for 8000 to 14000 sq. ft. at 20 lbs.



New Sterlco 4200 Series unit, for jobs where cast iron tank is preferred. Same ¼ H.P. pump as the 4100—for 6000 sq. ft. maximum capacity, 20 lb. pressure.

All STERLCO products are distributed through leading heating and plumbing wholesalers.

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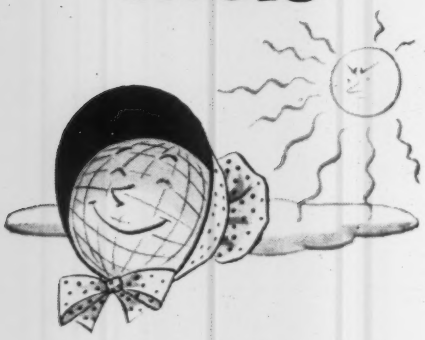

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EXHAUSTING JOB. Grease and dirt can cause fires in kitchen exhaust ducts . . . but not when an Air-Maze Greastop filter is on the job. It's one of hundreds of filter types designed by Air-Maze—the filter engineers.

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SILENCERS
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LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 169. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

No. 7262: Access Panels—Watson Mfg. Co., Inc., Jamestown, N. Y., has issued a folder on its flush fitting access panel designed for use with metal and wood lath, marble, tile, and plaster. Available in plain or grained finishes, the panels incorporate removable type hinged doors with an automatic backout device.

No. 7263: Air Diffusers—Said to contain all the necessary data to simplify the selection and sizing of "Agitair" square and rectangular diffusers types R, RV, and RTC, a new six page bulletin has been issued by Air Devices, Inc., 17 E. 42nd St., New York 17.

No. 7264: Air Filtering Costs in Central Systems—This is the title of a four page folder issued by Owens-Corning Fiberglas Corp., Toledo 1, Ohio. Data are contained on the costs of air filtration, with comparative figures on installation and maintenance costs of cleanable units and replacement type filters. A form is included for use in calculating comparative costs for a specific installation.

No. 7265: Air Recovery by Activated Carbon—In nontechnical terms, Bulletin 118 tells how the "Dorex" activated carbon system removes odors from air. Issued by W. B. Connor Engineering Corp., 112 E. 32nd St., New York 16, the booklet stresses the savings in equipment and operating costs which are effected by "recovering" air so it may be recirculated.

No. 7266: Arc Welding Service Directory—Lincoln Electric Co., Cleveland 1, Ohio, has issued a new bulletin (S.D.4) which contains a listing of authorized field service shops in 42 states, Canada, and Cuba.

No. 7267: Automatic Controls for Schools—A nontechnical booklet, prepared for school board members, superintendents, architects, and engineers, describes control systems for schoolhouse heating, ventilating, water temperature, refrigeration, and boiler rooms. The booklet has been issued by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8.

No. 7268: Cooling Tower Maintenance—Marley Co., Inc., Kansas City 15, Kans., offers recommendations in regard to the maintenance of gear boxes, water distribution systems, drive shafts, motors, filling, and cold water collecting basins in quiz sheet No. 5. The information is in the form of 10 questions and answers. Sketches and a maintenance check chart are included and painting of redwood and metal towers is covered.

No. 7269: Copper Tubing—Kensico Tube Co., Inc., Mt. Kisco, N. Y., has issued a number of price sheets dated April 25, 1949 giving net prices to distributors on seam-

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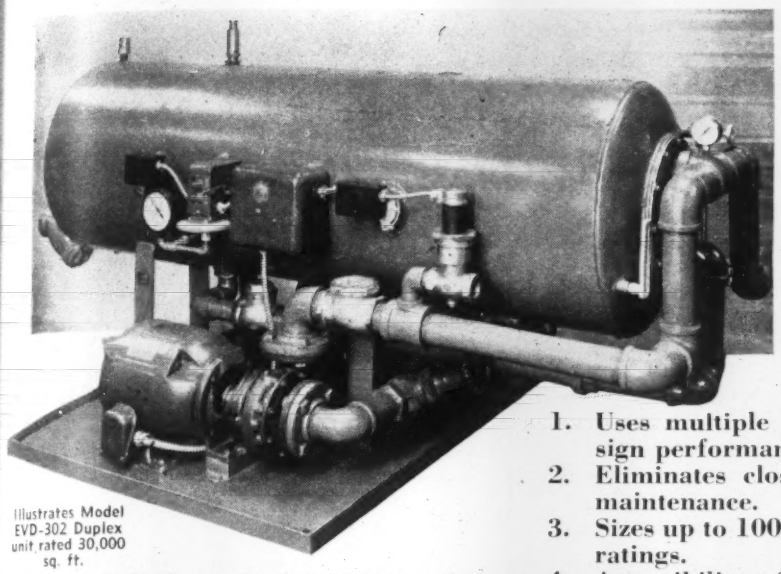

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less copper tubing, copper water tubing (types K and L), and refrigeration service tube. Also listed is type U copper tubing for gas and oil burner use.

No. 7270: Dryers, Valves, and Gages for Refrigeration—Henry Valve Co., 3215 North Ave., Melrose Park, Ill., has issued Catalog 99 covering its line of packless and packed valves, relief and check valves, strainers and dryers, and liquid level gages for refrigeration, air conditioning, and industrial applications. Design and construction features are described and illustrated and sizes, dimensions, and list prices are given.

No. 7271: Drying Coal—Directed primarily at the coal industry, Bulletin 449 of Geo. P. Reintjes Co., 2517-19 Jefferson St., Kansas City, Mo., leads off with a discussion of the importance of furnishing properly washed and dried coal. The firm's special furnaces for heating air used in drying surface moisture on coal are also described and illustrated.

No. 7272: Electrical Bus Bars—A four page circular explaining the features of the LVD (low voltage drop) "Flex-A-Power" bus bar has been issued by Trumbull Electric Mfg. Co., Plainville, Conn. The circular describes this unit as a busway that is used principally as feeder lines for the transfer of heavy current or as main feeders for power and light.

No. 7273: Electrically Heated Snow Removal Installations—About two years ago the Public Lighting Commission of the city of Detroit started experimenting with electrical snow removal on sidewalks and pavements. Since then, a number of experimental installations have been made in that city. A progress report by the commission is contained in the March issue of the house organ published by Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14.

No. 7274: Electric Heaters for Industrial Use—As a part of its promotional program designed to show how electric heat can serve industry, General Electric Co., Schenectady 5, N. Y., has issued five application data booklets on the major uses of tubular, strip, and cartridge heaters. Bulletins GET-1739, GET-1740, GET-1741, GET-1742, and GET-1743 respectively deal with heating pipe lines, melting soft metals, heating process air, heating liquids, and heating surfaces. Each booklet contains a section on how to calculate heating requirements.

No. 7275: Expansion Joints—Bulletin EJ-49, available from Chicago Metal Hose Corp., Maywood, Ill., was prepared to give engineering and product information on "Free-Flexing" and "Controlled-Flexing" corrugated type expansion joints in copper and stainless steel construction. Pertinent data are tabulated.

No. 7276: Extraction of Mist, Filtering by Wire Mesh Elements—Bulletin 11, issued by Otto H. York, Inc., 364 Glenwood Ave., East Orange, N. J., describes wire mesh filtering and separating elements for use in mist extraction, gas filtering, tower packing, cleaning, and baffling. Pertinent data as to available types, performance, mate-

The Perfect Oil-Burning Equipment Combination

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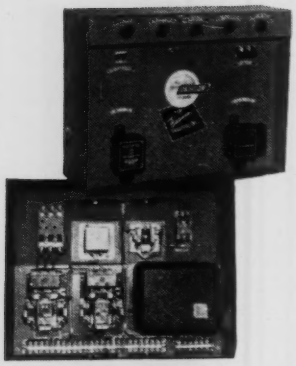

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Maximum	165	500	64,000	104,000

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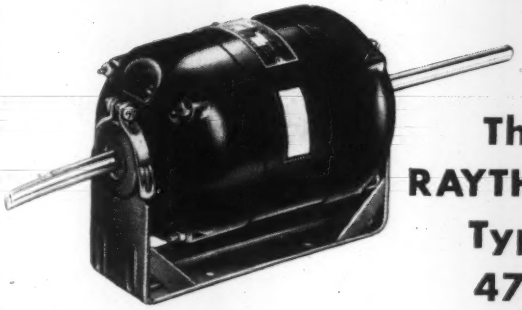

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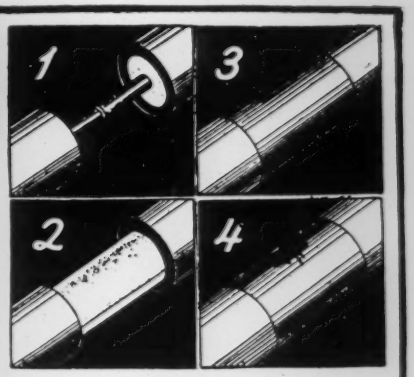

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MARTOCELLO SPRAY NOZZLES are of a sturdy, one-piece construction. Cast of high grade red brass — inlet and outlet accurately machined — offer LESS FRICTION — are less clogging and recommended for best overall efficiency.

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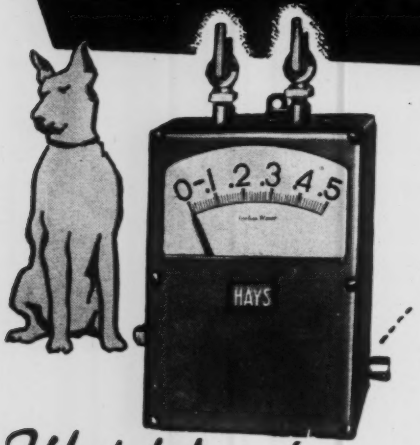

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It pays to stand watch over air filters, to guard against possible inefficiency due to excessive dirt collection. Install a Hays Air Filter Gage—It's quick and simple to install . . . indicates air resistance at all times . . . warns when filter element needs cleaning or renewal . . . eliminates guesswork . . . sounds an alarm (if desired) when dirt dams proper air circulation. Full information in Hays Bulletin 46-751. Write for it today!

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rials, limitations, and pressure drops are given and a number of applications are described.

No. 7277: Finishes for Aluminum—A new 124 page, 6 x 9 in. book entitled Finishes for Aluminum has been issued by Reynolds Metals Co., 2500 S. Third St., Louisville, Ky. Basic information is furnished on the various processes for applying surface finishes, as well as the characteristics of the finishes produced. This publication is a revision of the two volume book having the same title and published in 1946. The main difference between the new and old editions is that processes adapted to continuous production operations are now definitely segregated. A copy may be obtained by forwarding a request to the manufacturer on company letterhead.

No. 7278: Gas Burner—Available as a packaged unit and in sizes from 50,000 to 5,000,000 Btu per hr. the gas fired power burner developed by Ernest C. Lundt, Inc., Route 6, P.O. Box 216, Little Falls, N. Y., is said to have unlimited turndown, utilizes a low pressure fan for combustion air, and can be equipped with a variety of controls, depending on requirements. It is described in a new leaflet.

No. 7279: Gas Welding Rods and Fluxes—The new 16 page catalog of Air Reduction Sales Co., 60 E. 42nd St., New York 17, describes 19 different gas welding rods, eight fluxes, and includes a section on silver brazing alloys, plus a page devoted to carbon rods and carbon plates.

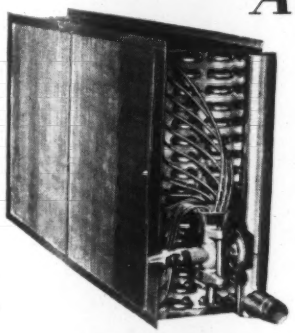
No. 7280: Glass Pipe in the Process Industries—Case histories in the form of illustrations and brief descriptions are contained in Bulletin EA-1 of Technical Products Div., Corning Glass Works, Corning, N. Y. The uses of "Pyrex" glass pipe in various chemical processes, food processing, and the wine and dairy industries are depicted.

No. 7281: Government Procurement—Trilane Associates-U.S. Government Procurement Service, 1 Hudson St., New York 13, has released a brochure explaining many short cuts in successful bidding and execution of government contracts. It has been prepared for manufacturers who have never submitted a bid, as well as for those who have been active bidders.

No. 7282: Hard Surfacing Electrodes—Applications and recommended arc welding procedures for its hard surfacing electrodes are contained in Bulletin 469 of Lincoln Electric Co., Cleveland 1. A chart shows relative resistance to abrasion and resistance to impact.

No. 7283: High Pressure Condensate Return System—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, has published an expanded 24 page bulletin (No. 3250) on its C-B high pressure condensate return system. In addition to material and operating specifications, capacity ratings are given for both the standard and high differential units in the six sizes available (3, 5, 7½, 10, 15, and 25 hp). Differential pressures to 200 psi are listed and capacities for each unit are tabulated after each differential pressure for unit inlet pressures from 0 to over 100 psi.

$26.00 per ton
Average Cost



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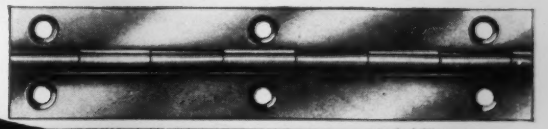

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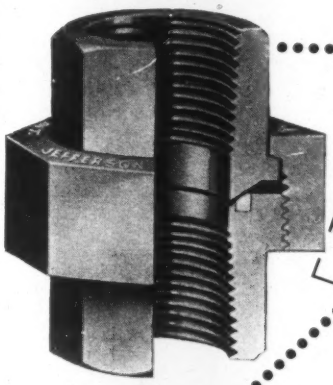

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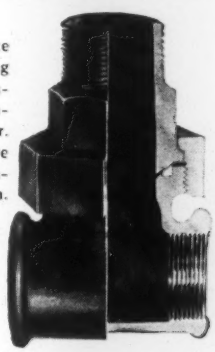

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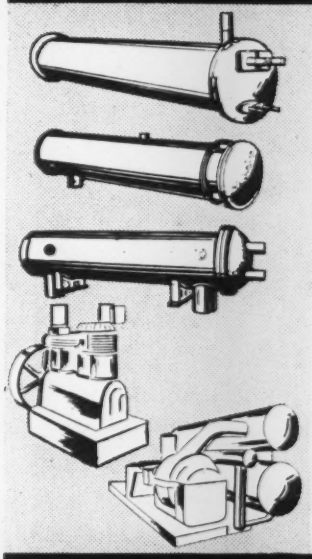

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No. 7284: High Pressure Valves—Catalog Section 12-H prepared by Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co., East Chicago, Ind., contains detailed information on cast steel valve designs with pressure seal bonnets for high temperature, high pressure service. Valves are built in both globe and angle stop, nonreturn, and check designs in sizes 6 in. through 14 in. for 900, 1500, and 2500 psi.

No. 7285: Horizontal Type Conditioning Units—Bulletin AC-171 of Kramer Trenton Co., Trenton 5, N. J., describes a comfort cooler of 2.75 tons capacity consisting of casing, coil, and propeller fan. Air conditioning units from 3.6 to 10.7 tons capacity are also covered. These utilize centrifugal fans and air filters, and heating coils may be added. Ratings and dimensions are tabulated.

No. 7286: Inert Gas Welding—Air Reduction Sales Co., 60 E. 42nd St., New York 17, has reprinted an article Practical Aspects of Inert Gas Welding, by H. A. Huff, Jr. and A. N. Kugler. Originally presented before the 29th annual meeting of the American Welding Society, the article provides a resumé of inert gas-shielded arc welding techniques.

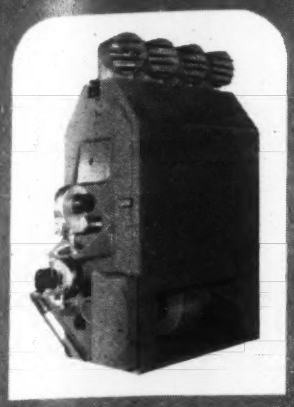
No. 7287: Laboratory Testing—United States Testing Co., Inc., 1415 Park Ave., Hoboken, N. J., has published a number of booklets on its testing facilities. Pamphlets on refrigeration testing and on heating, ventilating, and air conditioning tests describe available facilities. A price list gives information on engineering, bacteriological, chemical, food, leather, plastics, and optics tests. Testing and Research in Modern Industry is the title of a 113 page booklet which gives detailed information on the services of the company. Useful tables of equivalents, conversion factors, and other data are included.

No. 7288: Leather Belting—Selection, installation, and maintenance is the subject of a 26 page booklet released by the American Leather Belting Association, 41 Park Row, New York 7. Horsepower ratings, useful formulas, ordering instructions, thickness specifications, and specific recommendations for installation and maintenance are included.

No. 7289: Magnetic Motor Control—The new type GM line of magnetic motor controls is intended to protect a-c motors up to 50 hp against damage from overload and under voltage. Complete data, including information on types of disconnects, reversing and nonreversing starters, reversing and nonreversing contactors, and combination starters, are included in Bulletin TEB 8 issued by Trumbull Electric Mfg. Co., Plainville, Conn.

No. 7290: Mercury Relays—A new booklet, Bulletin 48, on a redesigned and improved line of mercury plunger relays includes outline drawings, photographs, and technical data. It is published by Ebert Engineering & Mfg. Co., 185-09 Jamaica Ave., Hollis 7, Long Island, N. Y. Units described handle loads up to 35 amp at 115 volts; 25 amp at 230 volts, a-c; and motor loads up to 2 hp at 115 volts or 230 volts, a-c.

No. 7291: Oil for Low Temperature Refrigeration Systems—The Vol. 13, No. 3 issue of the house organ pub-



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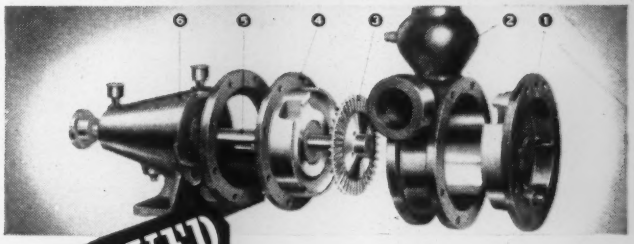

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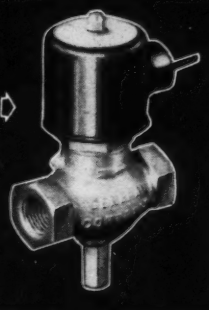

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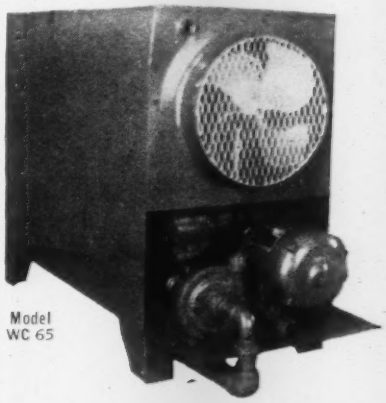

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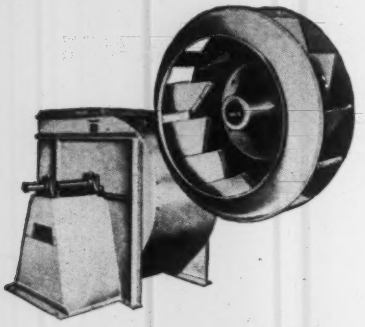

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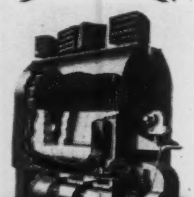

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lished by Ansul Chemical Co., Marinette, Wis., is largely devoted to the company's refrigeration oil which was designed primarily for low temperature applications but is said to be an "all-temperature" refrigeration oil. Properties are discussed in detail and specifications are given.

No. 7292: One Piece, Blind Rivets—"Rivnuts" are one piece, blind rivets with inside threads. They are upset with a heading tool and are operated either by hand or compressed air that transmits a pull on the threaded portion so that the thinner counterbore has to give. A bulge forms and the threads push the counterbored portion until the expanding metal seats itself against the material being fastened. A new "pull-tab" demonstrator showing how they are installed has been issued by B. F. Goodrich Co., Akron, Ohio.

No. 7293: Paint for Concrete and Metal—"Oncrete" is a synthetic, moisture repellent paint for use on concrete, cement, brick, and plaster. Containing virtually no oils or dryers, it is said to be immune to alkali and to provide a corrosion resistant, heat withstanding finish on metal surfaces. In addition to all types of masonry, it is recommended for use on ventilating ducts, air conditioning equipment, machinery, piping, and storage tanks. Properties and applications are described in a four page folder issued by Lowebco, Inc., 1525 E. 53rd St., Chicago 15.

No. 7294: Pipe Identification Markers—A four page bulletin has been released by W. H. Brady Co., Dept. 130, 815 N. Third St., Milwaukee 3, on its line of "Quik-Label" pipe markers. These adhesive backed labels conform to ASA Standard A-13 both as to color and the use of words to identify piping systems. Some 285 markers for virtually all types of fluids used industrially are listed.

No. 7295: Pipe Tools—A 52 page catalog covering its complete line of pipe tools, power pipe machines, power drives and accessory equipment has been released by Toledo Pipe Threading Machine Co., Toledo, Ohio. Units described include hand operated tools in capacities up to 12 in. pipe, power machines in three models for ½ to 4 in. pipe, power drives in three models for operating geared threaders and for other applications where power is needed, such as in opening sluice gate valves, turning a boring bar, operating winches, etc.

No. 7296: Prefabricated Ducts and Fittings—Combining both gravity and forced warm air heating fittings, Catalog No. 10 GAC covers wall stacks, register boxes, plenum chambers, branch outlets, adapters, boots, dampers, etc. Issued by Corbman Bros., 315-21 N. 7th St., Philadelphia 6, the booklet also describes registers, accessories, and numerous special fittings.

No. 7297: Propeller Fans—Catalog No. 3000 of Diehl Mfg. Co., Finderne Plant, Somerville, N. J., is a 16 page leaflet describing and illustrating desk and bracket fans; floor, counter, wall, and ceiling models; kitchen and attic ventilators; and several types of industrial and commercial fans. Catalog No. 3001 covers the company's line of exhaust and ventilating fans. Performance data, prices, specifications, and application data are included.

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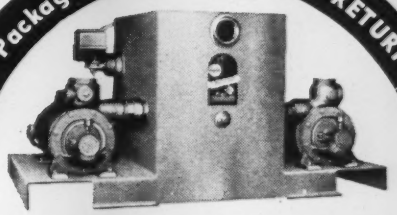

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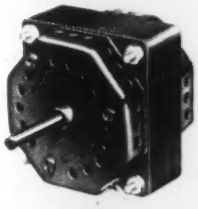
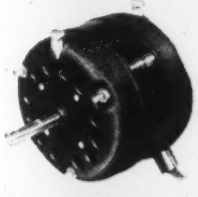
4-pole shaded pole motor. Approx. 1/30 h.p. 1550 r.p.m.





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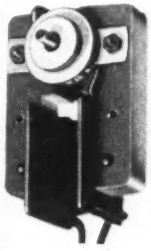

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No. 7298: Protective Coatings—"Perma-Skin" vinyl corrosion resistant protective coatings are recommended for use in a wide range of industries covering structural installations, machinery, and equipment of almost every type. Dennis Chemical Co., 2701 Papin St., St. Louis 3, has issued a new four page folder describing the coatings.

No. 7299: Repulsion Start, Induction, Brush Lifting Single Phase Motors—The type RS motors of Century Electric Co., St. Louis 3, Mo., are said to combine the starting characteristics of a repulsion motor with the running characteristics of an induction motor. Units from ½ to 20 hp are described in an eight page bulletin (Form 942) which gives information on performance characteristics and design and construction features.

No. 7300: Resistance of Monel, Nickel, and High Nickel Alloys to Corrosion by Sulfuric Acid—This is the title of a technical bulletin (No. T-3) prepared by the corrosion engineering section of International Nickel Co., Inc., 67 Wall St., New York 5. Problems involving a wide range of operations from pickling of steel to petroleum refining and textile processing are discussed. Containing 86 tables and 33 graphs and photos, the booklet covers the characteristics of over 30 nickel bearing metals in a variety of services.

No. 7301: Shell and Tube Refrigerant Condensers—"Junior" condensers in a range of sizes from 1½ to 25 tons and for use with "Freon-12" and methyl chloride are available from Doyle & Roth Mfg. Co., foot of 23rd St., Brooklyn 32, N. Y. Features, as described in a new leaflet, include high heat transfer, large pump down capacity, and cleanable tubes which are rolled into reamed and serrated holes.

No. 7302: Static Pressure Controls—The Vol. 3, No. 1 issue of the house organ published by Coral Designs, P. O. Box 248, Forest Hills, N. Y., is devoted to new explosionproof, dustproof, and splashproof static pressure controls. Units may be used to control the pressure in the intake of a duct, to measure and actuate an alarm when the drop across a filter reaches some predetermined value, etc. Standard ratings range from 0 to 20 in. of water or vacuum, with range adjustment.

No. 7303: Steam Specialties—Catalog 68A, released by Strong, Carlisle & Hammond Co., 1392 W. 3rd St., Cleveland 13, carries information on traps, strainers, reducing valves, and separators. Specifications, prices, and recommendations for selection, sizing, and maintenance are included.

No. 7304: Synchronous Motors—Operating advantages and construction features of its bracket bearing synchronous motors in sizes from 30 to 1000 hp are described in a new 16 page bulletin (05B6112A) released by Allis-Chalmers Mfg. Co., 1121 S. 70th St., Milwaukee, Wis. In addition to a complete line of open type motors, the company is offering units with special features such as grease lubricated bearings, enclosed collector assemblies, semi-protected, protected, drip proof, splashproof, separately ventilated, and totally enclosed motors. A table is included showing the sizes to which bearing pressures limit the application of two bearing motors.

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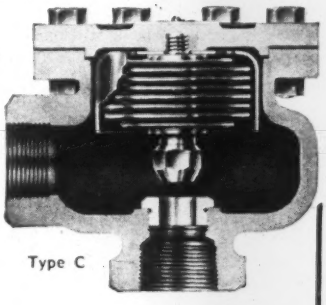
Due to Operation on Lowest Temperature Differential



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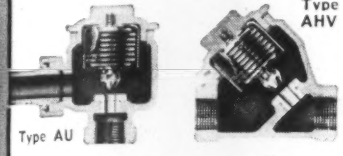

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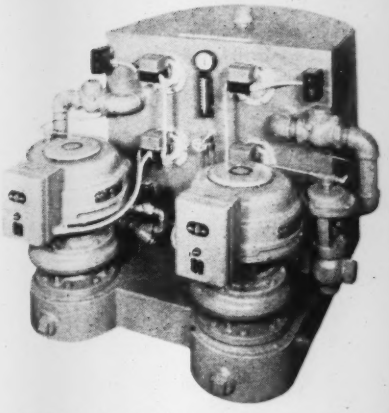

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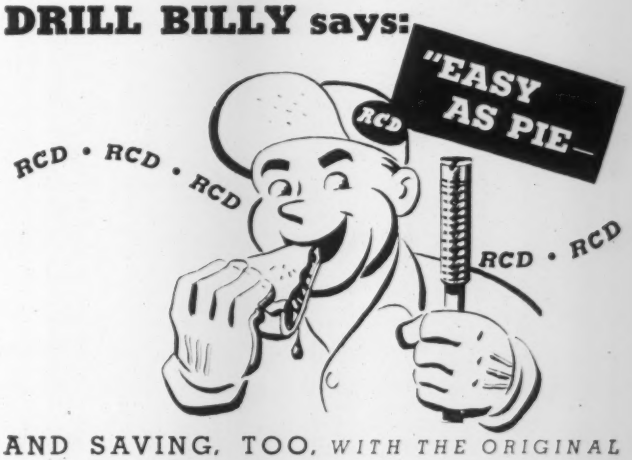

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